Australian Personal Computer

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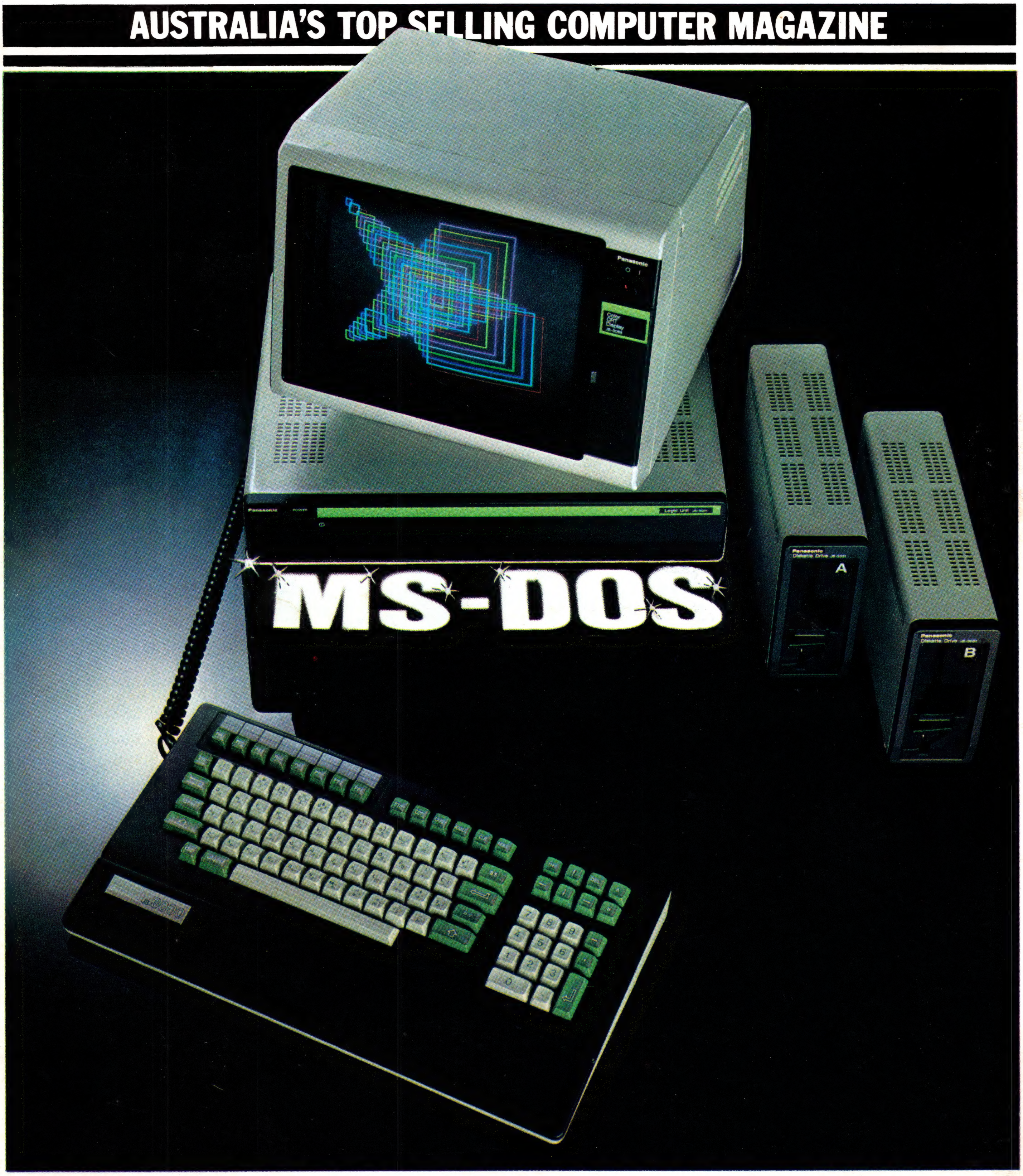

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National Panasonic JB~3000 Benchtested

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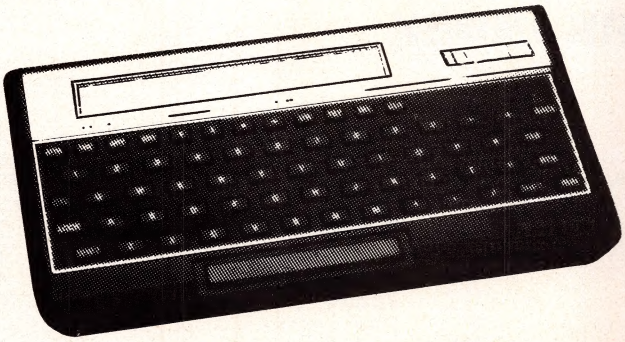

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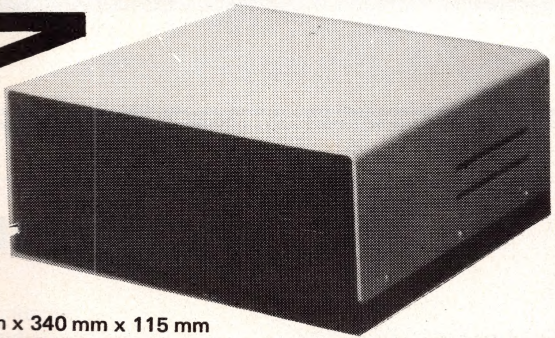
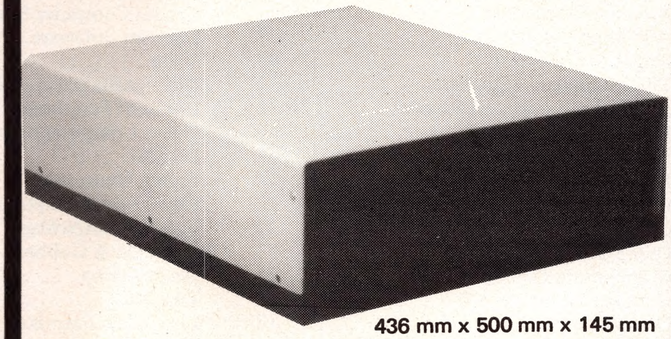
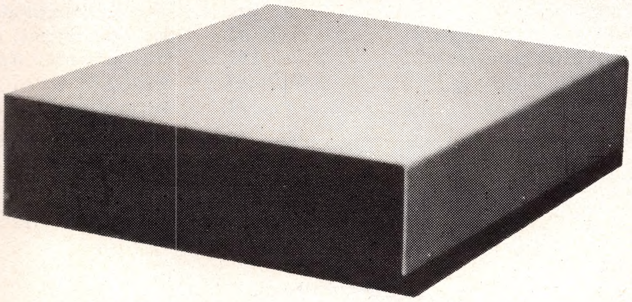


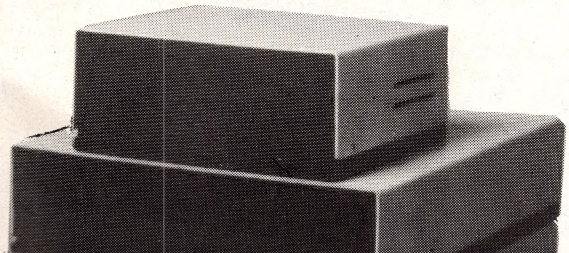
340 mm x 340 mm x 115 mm
designed to house Winchester 5¼ or 2 x 5¼ mini floppy drives.



436 mm x 500 mm x 145 mm
designed to take 1 x 8" fixed drive.



436 mm x 500 mm x 118 mm designed to house two 8" slimlines and accompanying circuitry. Slimlines are attached to top panel and are raised above keyboard.



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stackability
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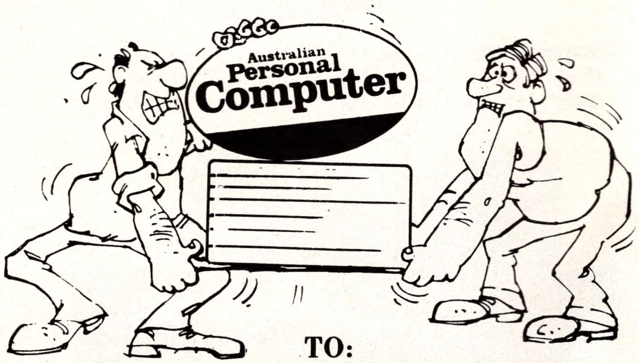

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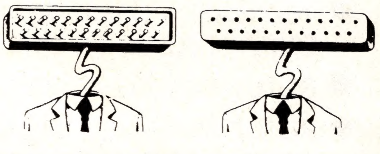

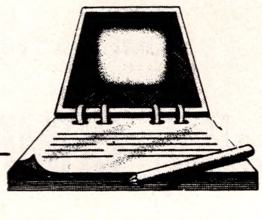

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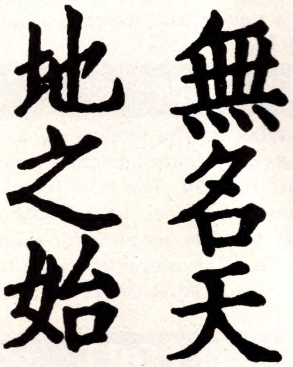

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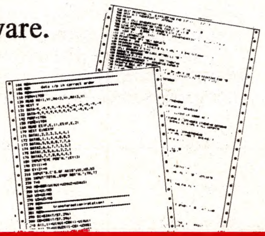

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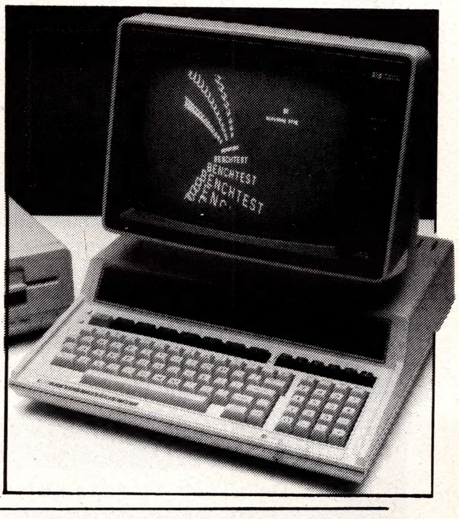

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APC reports on the latest from the world micro scene.

Virtual virtues

An awful lot of people (for example, those who use the Wordstar word processing program) know that it is possible to run a program that is too big to fit your computer by 'overlaying' bits of it as required – and they are normally very puzzled when firms like Zilog announce 'virtual memory processor units which eliminate the constraints placed on application programs due to main memory size'.

The essential difference between overlay and virtual memory management is that you have to work out the overlaying yourself, but the computer does it for you if it has virtual memory. Neither of these is 'virtual machine' operation, which goes one step further, and overlays the operating system and job control instructions too.

A virtual memory computer programmer sits down and writes code. He (theoretically) doesn't worry how long it is, but hands it over to the compiler, which generates a nice sequence of machine instructions, which it in turn passes to a loader, which feeds it into the computer memory and tells the processor to start at the beginning.

At some stage, the virtual memory management unit notices that the computer is about to access a memory location which doesn't exist. It only goes up to (say) 65535 memory bytes, and is now sending out a request for the data in byte 78009. Hastily, the virtual manager interrupts, fetches 78009 onwards from the disk, and re-labels it so that it actually starts at number one again.

The drawback is that all too often 78009 contains a quick test which turns out to call for location 25008, which is now location 46999. Processing stops while the new section of program is stored on disk again, and the old lot fetched back out. This can go on and on; it's called 'thrashing' and, in reality, programmers have to watch out that they manage their plans so as to avoid it.

Nonetheless, you don't get omelettes without breaking eggs, and the omelette is a

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This module, unlike other accessories fits neatly inside the keyboard. The module comes ready built, fully tested and complete with a 4k graphic ROM. This will give you 448 extra pre-programmed graphics, your normal graphic set contains 64. This means that you now have 512 graphics and with inverse 1024. This now turns the 81 into a very powerful computer, with a graphic set rarely found on larger more expensive machines. In the ROM are lower case letters, bombs, bullets, rockets, tanks, a complete set of invaders graphics and that only accounts for about 50 of them, there are still about 400 left (that may give you an idea as to the scope of the ROM). However, the module does not finish there; it also has a spare holder on the board which will accept a further 4k of ROM/RAM. IT NEEDS NO EXTRA POWER AND WORKS FROM YOUR NORMAL POWER SUPPLY. $124.95

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genuine increase in the ability to write programs in languages like Fortran, without worrying how much memory the user will have to have. In other words, to write programs for nearly any machine that can run the compiler.

The chips which Zilog has announced are the Z8003 and Z8004 processors, which will run all software already produced for their predecessors, but will also organise longer programs into segments. The difference is that the Z8003 generates 23-bit addresses organised into 128 segments of up to 64 kbytes each, while the Z8004 generates 16-bit addresses.

The chips will actually start being available around the end of this year.

IBM clones

While we are all waiting for IBM to find somebody with enough nerve to struggle up the cargo loading bay with its Personal Computer and launch the damn thing in Australia, all is not yet sweetness and light in America.

Two minor niggles have provoked outside manufacturers into trying to compete with (or improve on) IBM's design – one is the keyboard, the other the display.

It is known that IBM's monochrome display is slightly unusual in that it has 'high persistence' – that is, the glowing characters on the video screen fade slowly. If the screen scrolls it is almost impossible to see what is going on because the screen shows the mixed-up overlays of three or four lines together.

Those who have experimented with a short-persistence display, however, report that it may not be an accident that IBM selected the high-persistence phosphor. There is, they say, a decided flicker which seems to be caused by a hardware or software fault in the display.

Other people, less technically experimental, have been known to reject the IBM Personal Computer because they can have colour or monochrome – but not both.

The display problems are minor niggles, but they have provoked a Michigan company to make the startling announcement that it has 'improved' on the IBM PC by launching the 'Portable IBM Color PC'.

The keyboard is an even smaller niggle but matters more. Simply, the keyboard is nearly unusable by ordinary typists, because the SHIFT and RETURN keys are not where touch-typing fingers expect to find them.

The result is that the very well known keyboard design company Key Tronic in Washington is planning to sell IBM a redesigned keyboard of a more orthodox or up-to-date style.

The really entertaining side of the whole business is that while Key Tronic's venture has attracted much interest, the Michigan Color PC has attracted nothing but derision.

The company, Applied Systems Corporation (ASC), seems to believe that the Intel 8088 chip used in the IBM PC is in fact an IBM 8088 chip. It has also announced that it will put the IBM logo on the front of the box.

That's a suggestion to which IBM has yet to respond, but the company has in the past been known to prosecute people (like British computer company ICL) merely for mentioning the letters IBM in their own advertisements, even when saying merely that something was 'IBM compatible'.

The other rather strange thing that ASC says is that it will use IBM's own keyboard.

It is, perhaps, possible that when IBM switches to the Key Tronics keyboard (if it does), it may have a huge keyboard factory somewhere filled with Mexican workers who want desperately to continue to work, and that in compassion for their plight IBM will sell the useless old-model keyboards to ASC – but it will be the first time IBM has ever done any such thing if it happens.

A healthy scepticism about ASC is therefore probably justified.

Meanwhile, those who like the IBM PC but want a bigger and faster version can look to the announcement of a machine called the Gazelle, just emerging from an American firm called Seattle Computer.

Seattle Computer has a distinct edge over most hardware producers who hope to imitate the IBM computer: it was the company that Microsoft commissioned to write the IBM PC operating system, MS-DOS.

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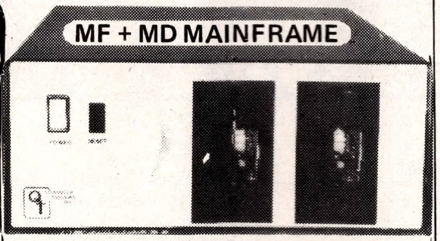
MF + MD MAINFRAME



The MD+MD Mainframe offers the same quality as the MF+. It accepts two 5 1/4" disk drives with remaining space for either a 6, 8, or 12 slot Silence Plus Motherboard.

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So for around the old price of the typewriter you can have a classy typewriter/printer able to operate on either the RS232 or Parallel standards. Complete with self test, hold control, and the special CODE functions built into the typewriter.

So what can we say?

THANKS IBM !

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SYSTEM 80 INTERNAL MEMORY

CHECKOUT

The Home Accountant

If you want to know how much you're worth, there's a program that has been released recently in Australia called The Home Accountant. It was written by Continental Software in the US for that market so allowances must be made for Americanisms including references to US companies as suppliers of specific stationery although well known Australian computer consumable suppliers, such as Computer Resources, would be able to provide stationery requirements. Fortunately, the most commonly seen irritation of US software, the "month-day-year" format is alleviated by actually spelling the month to produce a more readable "Dec 21, 1982" format.

The program is designed to decrease the amount of time the average householder has to spend budgeting for rental payments, coping with writing copious numbers of cheques and accounting for automatic bank transfers. Now, this may not seem all too difficult to you but apparently a lot of people come unstuck with such everyday complications.

The system uses up to one hundred budget categories to pigeon hole each type of expense, asset, liability or income. These categories can then be modified by the report routines to produce statements of nett worth, income and expense summaries, transaction summaries, comparative balance sheets (comparing current standing to a proposed or a previous month), specific expense reports (e,g, how much the 7 ft dingy is costing your family) and most importantly, a credit card/cash activity report.

Particularly large or wealthy families can benefit from the cheque writing facility to cope with the monthly bills although most users would probably opt for the old fashioned (and less expensive) hand written method.

All one hundred categories can be displayed on the Apple screen using one of three types of graphs: the bar graph compares actual versus budgeted expenditure; the line graph presents a point-to-point plot of any existing category to show actual expenses comparing up to three different categories simultaneously using different colours; and the trend analysis graph to an historical view of the expenses of several categories again using several colours.

Other facilities of the Home Accountant are a search/edit mode to display transactions by data, cheque number, payee, amount and/or category; ability to keep track of up to five cheque books and five cash accounts; and provision for "flagging" transactions to be recalled for tax purposes.

You'll need an Apple with 48k, Applesoft and one (preferably two) disk drives. A printer would also be very handy. The documentation is excellent, with sample output and clear directions for even a computer novice as to how to set-up and operate the system.

If you want to know how much you're *now* worth, buy Home Accountant, produce a balance sheet and add $93.95!

The Gazelle, unlike the IBM PC, uses the full 16-bit implementation of the central processor chip. That is, it uses the Intel 8086, not the sawn-off 8088 version, which makes it bigger and faster but allows it to run exactly the same software. This was always the plan, of course, but perhaps few people expected a direct challenge quite so soon.

Price of the Gazelle in America, including MS-DOS, plus Basic (Microsoft) and a word processor program called 'Perfect Writer' is $6000 but that doesn't include a display or keyboard. So it's not likely to sell in its hundreds for quite a while.

Movie magic

Someone was asking recently what the point was of all this enormous drive to bigger and better machines.

Is it a plot, he asked, a scheme by the industry to get us to make our nice 8-bit word processing and spreadsheet machines obsolete just so we can chase after new 16-bit and 32-bit stuff? Who needs all the 'extra power' anyway? We can't type fast enough to keep up with the slowest micro today . . . and so on.

If any designers are reading, then here is a small inspirational idea along those lines. The first order for the world's most powerful computer available for sale is not from the weather forecasters, nor from the big banks, but from an animation outfit. It makes animated films.

No, it doesn't make cartoons. It uses the new super-Cray processor to plot the individual 'grains' of colour film and simulate photographic action. Working flat out, this outfit (Digital Productions Inc) used to be able to churn out one whole frame in a quarter of an hour on its old Cray. On the new one, it will go a lot faster.

Apparently one frame per quarter-hour is around four minutes of film per month, and the new machine can give nearer half an hour's worth of action in that time.

Your average micro can't do this, nor anything like this. The fastest micro likely to be on the market in the next 12 months or so, based on a chip like National Semiconductor's 16032 (a quasi-32-bit design) would be pushed to plot two minutes' worth of movie viewing per *year*.

The thought, however, is this: drawing pictures is in many ways easier than recognising them. But the power needed to produce two minutes of movie that could be mistaken for camera film could be harnessed to the sort of burglar alarm that could tell the difference between a dog and a human, even if it didn't stand a chance of telling the difference between me and my aunt Maud.

And when Cray machines are priced at the level Sirius machines are today, an awful lot of dreams will suddenly become easy, normal and useful.

Think of the possibilities . . .

Sneak preview

On the subject of President Computers, a new IBM PC compatible micro called the Columbia has been announced. Its specifications are 128k of RAM, dual RS232 ports, centronics parallel port, floppy and winchester disk controllers and eight IBM compatible slots for add-on boards.

It runs MS-DOS of course and CP/M-86. Other software including a WP and financial modelling package will be offered with a business system in an all up price of around $5,600.

Portable wars

The portable micro market is taking on an interesting development. While many manufacturers are concerning themselves with cosmetics and 16 bit processors, the makers of leading portables have little time for appearance but place great emphasis on free software.

The Kaypro II is now providing, with the basic machine, a data base (Perfect Filer), word processor and Spelguard-type program (Perfect Calc). And in a generous gesture, President Computers, distributors of the Kaypro will be providing existing purchasers of the machine with these packages at no cost.

Applications packages also included in the deal are a suit of personal finance, small business and investment analysis programs.

Dare we?

At the risk of incurring the wrath of Apple we're going to tell you about a micro that sells for $455 and runs Apple II programs. The Micro-Professor MPF-II boasts 64k of RAM, a 16k ROM and an Extended Basic interpreter. Standard peripherals are also available (except the disk drive which is expected in early '83) from Computer Edge at 364 Ferrars Street, Albert Park 3206. Telephone (03) 690 1477.

Micro courses

Computer Tutor of Moorabbin, Victoria, is offering a series of ten and twenty hour courses on Basic. Participants are entitled to free use of a computer at any time during scheduled "open access" sessions and "pay-as-you-use" access is available to others at $3 per hour.

Sixteen courses are scheduled between now and Xmas. To enrol write to P.O. Box 129, Moorabbin, 3189 or telephone (03) 555 8456.

Sorcerer compiler

System Software has just released a Basic Compiler for the Exidy Sorcerer. The system converts Standard Basic Source code into stand-alone pseudo-machine code, which will execute up to 25 times the speed of the original Basic program.

Additional features include optional integer variables, byte arrays, high resolution graphic commands and a host of Extended Basic commands. The $69 price tag is sure to appeal to many Sorcerer users.

Contact System Software,
1 Kent Street, Bicton 6157.
Ph: (09) 330 7336.

Mock turtle

Yet another version of the Logo language (that's the one that draws pictures by directing

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Operating system ________
Are you able to electronically communicate over phone lines? Yes/No
Electronic Mail User Names/ID
Aust. Beginning ________
The Source ________
Other (specify) ________

an imaginery turtle around the screen with its tail dripping ink) has been launched from New York by Krell Software.

Priced at $99, this one (like most Logo packages) runs on Apple II and is described as a 'no-frills' version. You get three disks, two containing a 'fully authorised MIT copyrighted version of Logo' and the third with 'invaluable MIT applications, including Dynatrack, Rocket, Animals, The Sound Editor, The Shape and the Logo Assembler,' says Krell.

Details from 1320 Stony Brook, NY 11790; Tel: (516) 751 5139.

One-chip modem

There is a big demand for telephone directories and it wouldn't exist without lots and lots of telephones. Similarly, when there are lots and lots of computerphones (by which I mean modems that connect computers to the phone lines) there will be a big demand for things like Prestel and bulletin boards and useful stuff like that.

One step towards lots of modems is missing: a cheap modem. Cheap, in this business means using only a few chips. And I am therefore delighted to observe that Texas Instruments in France is putting together a one-chip modem for computers and Prestel sets.

The chip will not receive ordinary slow (300 bits per second) communications – which is a real shame, because there are quite a few people around who transmit that standard. However, it may not matter. It will receive at either 600 or 1200 bits per second, and it will transmit at 75, or 150, or 600, or 1200 bits.

Frankly, anybody who has ever used a 300 baud communications line will be delighted at the thought that this might become obsolete, because it is painfully slow. If you have a screen of data coming laboriously onto the display at 30 characters per second you can virtually read it as it is printed – and normally we want to read the bottom line first.

What makes the chip really interesting, however, is the fact that it will, according to TI, work with both European and North American standards – which means that modem builders who use this chip can expect a much bigger market than before – which in turn means cheaper modems.

By this time next year, we may see the first early productions using it, I hope.

Why Wicat?

Lionel Singer – the man who launched Prime in Australia – has lifted the lid of his latest venture, Wicat Computer of Australia.

The new Wicat systems offer 32 bit processors which have 16 megabytes of main storage and offer "unprecendented price performance" – according to publicity blurbs.

The multi-user operating system used on Wicat systems can support up to 32 users running programs in Fortran, Cobol, Basic, APL, Assembler, or C. Unix V7 is also available, as is the MDBS data base management system. Direct access disks range in capacity from one megabyte up to 470MB.

As well as launching the powerful new systems, Mr Singer has pulled another rabbit out of his hat with the appointment of Dr Vance Gledhill, formerly the head of computer science at the University of NSW, as managing director of Wicat Australia.

Explaining Wicat's approach, Dr Gledhill says: "Wicat is not in the personal computer marketplace, selling through dealers to small end users. Instead, we are offering large system capability to the top 200 companies, educational institutions and Government departments which require an economical solution to distributed data processing.

"We see Wicat Computer offering a stable base for the development of an Australian software industry." (A noble gesture indeed.)

Wicat Computer of Australia is a wholly Australian-owned company with support established in Melbourne and Sydney. The easy to use software is said to be derived from the mainframe computer environment.

The founder and chief executive of Wicat Systems Inc, the American supplier, Dr Dustin Heuston, says the Australian company is the first in the world to be given the right to use the Wicat name.

Mr Lionel Singer, chairman, WICAT of Australia Pty Ltd (left), Dr Dustin Heuston, chief executive officer, WICAT Systems Inc, and Dr Vance Gledhill, managing director, WICAT Computer of Australia (right).

Bludners extra

There were a couple of bugs in the DIY Logo program printed last month (page 41). Here are the corrections needed.

The QUIT statement mentioned in the article is not in fact implemented in the listing. To make it work add this line:

```
4084 IF SYS$=“QUIT” THEN
I=0 : GOSUB 9010 : GOSUB
28000 : GOTO 4200
```

Set K4 in line 10050 to 35 and add this line:

```
10170 R$(34)=‘QUIT’:
R$(35)=“AND”
```

This also corrects a bug which would have allowed you to define a procedure called AND despite the fact it is a reserved word.

Finally the RIGHT statement as written in fact moves left on the screen! To alter this change AN-C(S) to AN+C(S) in line 23500.

Some readers have queried the ON . . . GOTO in line 20130 which has three apparently unresolved line references. These values should never be selected unless there is a typing error somewhere else in the program. If it disturbs you it would be best to write error traps for the three lines involved, 23600, 23700 and 23800.

New Computerland

Following the announcement of closer links between Apple and its Australian distributor, Electronic Concepts, comes news of a joint venture between Computerland Corporation of the US and Computerland Australia.

The joint venture will operate all Australian Computerland shops so far opened by the Australian group. The agreement has been signed by Computerland Corporation representatives and the owners of Computerland Australia, Rudi and Lorna Hoess – coincidentally, the same people behind Electronic Concepts.

Chairman of Computerland Corporation's board, Mr William Millard, says the purpose of the joint venture is to "provide additional support from the US corporation and to provide a permanent structure for the Computerland stores in Australia".

"We have seen that Australian customers respond to the Computerland concept of highly professional full service stores. We are supplying that concept and our franchising experience; Computerland Australia Pty Ltd brings to the venture its knowledge of the Australian marketplace."

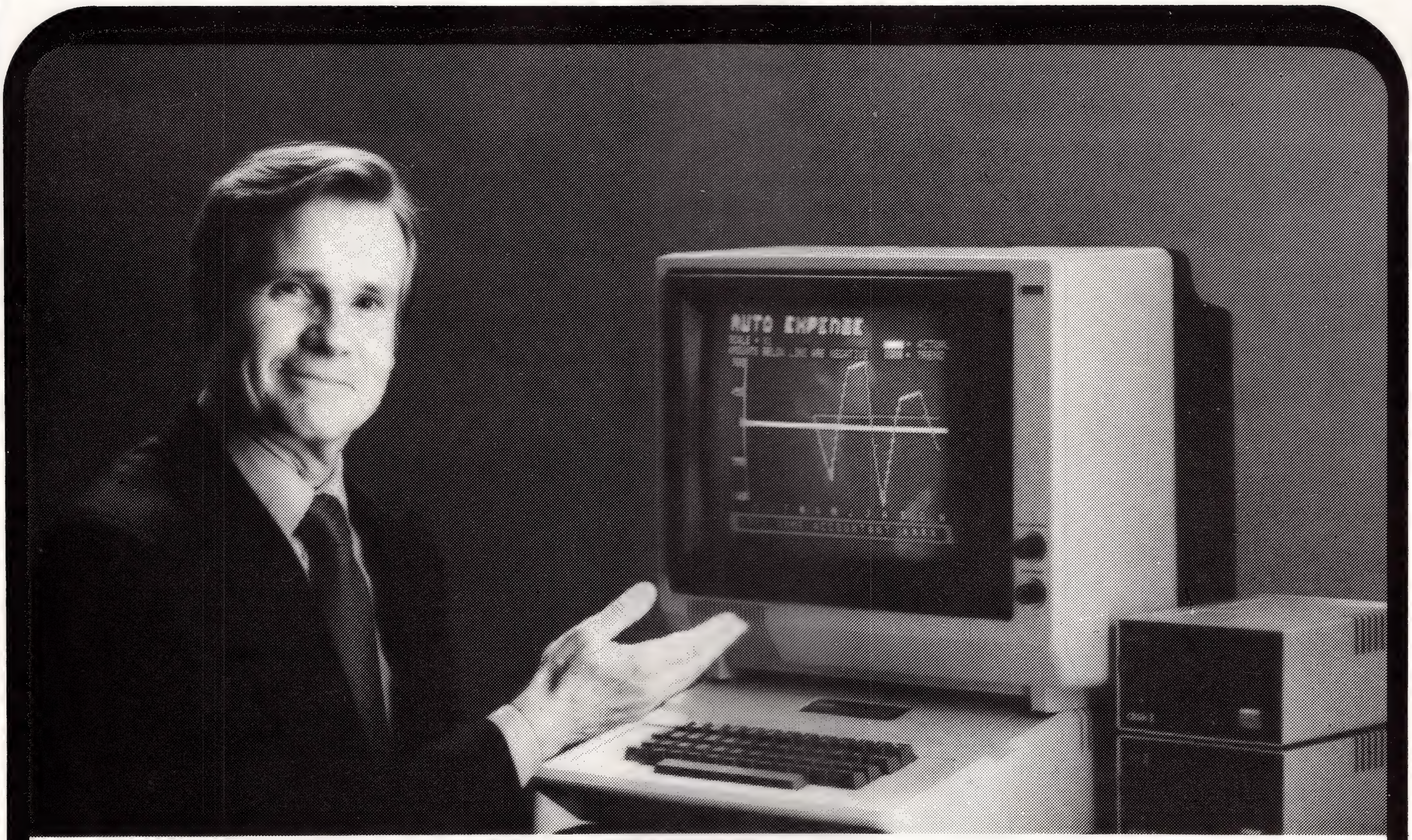
The new company will be supported and staffed by both parent companies, and will be based in Sydney. Previously, the group formed by Mr and Mrs Hoess was a sub-franchise of the US corporation.

A similar joint venture has been reached with a Japanese company, making the Australian move only the second such agreement for Computerland.

Zilog flood

Around a year ago, we all noticed (didn't we?) a lot of announcements of microcomputers based on the Motorola 6809, plus the beginnings of software support for those machines. Now the fuss has all faded into the background and we will continue to live in the real world of PETAppleTandy and CP/M as before.

This year we must all try to convince ourselves that the flood of announcements of machines based on the Zilog



CONTINENTAL'S HOME ACCOUNTANT IS NUMBER ONE—AND CLIMBING.

For the past several months, Softalk magazine has rated Continental Software's Home Accountant™ No. 1 in its "Home 10" best-seller list.

A lot of programs would have "peaked" by now. But with over 10,000 copies in use, Home Accountant just keeps getting stronger.

There's a reason for this spectacular success—and it's not just the low suggested price of $94.95.

The fact is, Home Accountant is one of those rare programs that virtually everybody can profit from using. It's powerful enough to handle even the most complicated family budget—yet it's so easy to use that one quick trip through the manual may be all you'll ever need.

With Home Accountant you can track up to 100 budget categories, 5 different checking accounts, and all the credit cards you can carry. Just press a few keys and watch the program print your checks, net worth and other financial statements. And when you see the full-color graphs of actual vs. budgeted expenses, trend line analyses, etc., you'll know you bought the best.

See your Apple dealer soon for a demonstration. And start watching your fortunes climb with Home Accountant*

Available from your local micro computer dealer.

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2 GP-IB interface
(IEE standard 488-1978 compatible)

3 RS-232C interface

The model VP-6801A, A4 type multicolor intelligent digital plotter is designed for use in graphic writing and recording in combination with personal computers and measurement systems with micro processors.

It features high speed writing of 200mm/sec, 6-color graphic functions and versatile intelligent software such as interpolation function, circle drawing, X and Y grid drawing, and X and Y axis drawing. Various marks and alphabet drawing are also available with desired size and direction. The print mode is useful as a printer with 60 characters x 40 lines for LIST print out and self check of the plotter.

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Z8000, a powerful 16-bit micro, is not a similar silly season hiccup, and that in July next year we will start seeing a small flood of Nat Semi products as a slight intermission to the real world of IBM and Sirius.

Certainly there are some very nice machines based on the chip which won Adam Osborne's White Elephant Award in San Francisco last year (the award was not denigratory but a genuine triumph of tradition over metaphor). Olivetti, Onyx and others are selling, and others will appear.

The good news has been reinforced by Zilog drawing our attention to the fact that its silicon partner AMD has not, after all, backed out of its agreement to make Z8000 devices.

'The unfounded speculation,' said a triumphant Phil Pittman of Zilog (and ex-Sinclair designer) 'that has been rife concerning a possible rift between Zilog and AMD has now been very firmly squashed.'

He was referring to a new cross-licensing agreement for the whole range of Z8000 processors and support chips.

My own feeling, which isn't much more than opinion, true, nonetheless remains lacking in staunchness of faith, and I still expect the future to be a battle between Intel and Motorola, with Intel eventually winning in 16-bit designs simply by beating everybody over the head with IBM.

One other, small, point which I know Phil Pittman will be grateful for my remarking on: the 'speculation' was not 'unfounded' but 'wrong'. It was founded quite firmly on the news that AMD had signed a deal with Intel, based on the 8086 family of chips – and nobody is pretending that *that* agreement has been ended.

NEC unveils handheld

NEC and sister company New Japan Electronics have jointly announced a new series of lightweight hand-held computers – the PC-2000 series.

The new PC-2000 is scheduled to sell in Japan for Y59800 ($238) and at only 600 grammes is one of the lightest machines of its type around.

Although designed by the team who produced the PC-8000 and PC-8800 series, production will be under the control of New Japan Electronics, better known for consumer items such as hi-fi products and colour televisions Shipping is due to start from November, and yearly production is stated as 50,000 units initially.

The PC-2000 comes between the PC-8000 and PC-8800 series and is to be marketed to business users,with an eye on its software and hardware compatibility with the existing product range.

Technically, the PC-2000 offers some quite advanced features. The liquid crystal display is a 40 column window on a maximum column width of 170 characters with upper and lower case, numerals and user graphics. Interfaces for cassette, serial port and parallel port are built in. The machine comes with 8 Kbytes of RAM and N20Basic (said to be compatible with NEC's N-Basic) comes in ROM. ROM cartridges and program cassettes will be available for specific applications and the company is said to be preparing 50 applications packages in time for the launch.

Other features include a keyboard that conforms to that of the PC-8000, an auto power off function, memory retention of up to one year with battery back-up, a built-in clock, 31 'musical' tones, five function keys and a low consumption of 130mW, allowing the PC-2000 to be run by just four AA type batteries. The size is 220 x 130 x 32 mm and weight is 600g.

QT moves

Q T Computer Systems has moved to larger premises at 41 Sydney Street, Marrickville.

They now provide a ground floor showroom for over-the-counter retail sales, and the factory area includes a service department for warranty and after sales service. Telephone number is (02) 519 2680.

Legend packing speeds up Pascal run times on Apple

Legend Industries Ltd, a Pontiac, Michigin company, has put together a package that allows Apple II users to run Apple Pascal 1.1 94 per cent times faster than they could before.

The package comprises a 128 KDE disk emulator RAM board, a Stellation Two 6809 Mill and a Super I diskette to contain the operating software.

The 128 Kbyte disk emulator card takes only one Apple slot and looks to the computer like an almost instant access disk drive. The 6809 card also plugs into an Apple slot and brings the power of the not-so-popular but highly 'orthogonal' 6809 CPU to the system. The two cards are 'tied together' by the Super I software on disk.

Recommended retail price in the States is US$749.

A fit of the vapours

We *APC* types love good esoteric jargon; we have crazes which last for weeks on particularly barbarous jargon words. Sometimes we go as far as to deliberately introduce them into articles as a sort of private joke or dare, but usually we restrain ourselves and keep them for office circulation only. A favourite for many months was 'orthogonal' used in such contexts as 'this coffee isn't very orthogonal' or 'that's a rather orthogonal shirt you're wearing'.

'Functionality' enjoyed a considerable vogue, especially when combined into such hybrid horrors as 'just nip out and probe the periphery of the functionality envelope of the coffee machine please'.

We were therefore tickled pink when Chris Buckham brought us back a real live specimen from the West Coast, namely 'vapourware'. This fascinating concept refers to software which has been announced but doesn't exist yet; there is a lot of it about (or not about, depending on the philosophical school to which one belongs).

The principle established is an excellent one and we hope to add to the list of 'wares'; for instance 'fogware' could be undocumented software. We leave the definitions of 'rubberware', 'noware', 'someware' and 'edgeware' to the readers.

Sinclair add-ons

A Melbourne based company has released a number of upgrade products for the ZX80 and '81 micros. These include a 32k Dynamic Ram Pack which sells for $165; a programmable character generator ($95); and a video upgrade for the ZX80 to

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SORCERER
BASIC COMPILER

SYSTEM SOFTWARE
wish to announce the release of
their long awaited
BASIC COMPILER

The Compiler is a 21K menue driven machine code program that converts a Standard BASIC program into object code. This code may then be executed up to 25 times the speed of the original BASIC program. The compiled code is 'stand alone' and does not require the compiler in memory in order to run.

No longer does the user have to worry about the slowness of BASIC. He can now program in the language he is accustomed to, and expect essentially machine speed execution. Compiled BASIC games make animation and graphics movement a reality. Compiled BASIC business programs reduce waste computation time and increase staff productivity. Compiled real-time interface programs eliminate the need to program assembly language in order to drive printers and the like. A compiler is an invaluable tool to both programmers and users.

The user may specify Integer Arithmetic and Byte arrays. This greatly speeds execution and saves memory space. Advanced string handling techniques have also been implemented in order to reduce the need for string garbage collection and compaction, again increasing execution speed.

In addition to all BASIC ROM PAC commands, the compiler supports the following features and commands:

- Optional Real, Integer or Byte Arrays
- Optional Real or Integer Variables
- SET (High resolution graphic set command)
- RESET (High Resolution graphic reset command)
- MID$ (On the left hand side of equation)
- CLOAD* A$ (Load string array)
- CSAVE* A$ (Save string array)
- IF — THEN — ELSE
- PRINT @   CVI   CVS   XOR
- MKI$ MKS$ INSTR   INKEY

This compiler has been designed to complement the Sorcerer, enhance its usefulness and expands its limits. It must be one of the most complex and worthwhile projects ever undertaken for the Sorcerer computer.

Normally a highly specialised piece of software such as this, is worth many hundreds and even thousands of dollars. Most compilers are priced from $200 upwards. We plan to change that.

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Allow $3.00 for airmail postage.
The manual alone may be purchased for $10.00

PRINTOUT

prevent the annoying 'think and move' fault to allow simultaneous computing and screen display ($38.50).

For more information, 'phone Vendale on (03) 232 0444.

More Sinclair add-ons

Axiom Software is selling arcade-style games for the ZX81. The best of these, QS-Defender, uses a machine-code display routine to squeeze more characters on the screen than is possible using ordinary PRINT statements (the display-file is expanded to 32 lines each of 31 characters).

The add-ons include a hi-res graphics board, a sound-generator and a programmable character generator.

Bubble blowing

Two chip-making companies, Motorola and Intel, are not normally very co-operative so the announcement of an agreement between these two to cooperate on developing Intel's range of bubble memories either proves that the project is very complex and needs heavyweight effort, or that neither side is really too much bothered.

Bubble memory is semi-conductor memory that doesn't evaporate when the power is disconnected but it is slow and it hasn't turned out to be as cheap as was first hoped. It was seen as a possible rival to disks when disks were expensive, and nowadays is more realistically viewed as a sophisticated way of producing a disk system which can't get clogged up with dust, or which can be bounced around.

The two companies agree that we won't see any of these new bubbles arising from their joint splash until the middle of next year at the earliest, from which you can deduce that products with these bubbles will have to wait even longer. So don't sell your disk company shares just yet.

Ambidextrous cabinets

Techframe Developments, a division of N E Edmonds Pty Ltd of Hornsby have a range of cabinets and chassis for micros which accommodate the three or four components of a standard system (which Techframe will supply if required) and the associated spaghetti of computer cables into a more orderly arrangement. While this in itself is not startling, what is good news for micro users is that the company is offering to custom design cabinets and chassis in sheet metal and/or plastic to the users' requirements. In addition Techframe can supply hardware items such as fans, line filters and appropriate power supplies.

So, if you're left handed like me, you no longer need to balance note books, program listings, etc on your left knee – rather Techframe will make a left handed cabinet and drive system. Ask for Jim Beale and you are in the right hands, (02) 476 3377.

Apple computer courses

City Personal Computer is introducing a range of computer courses geared to both the business and personal user of Apple computers. The first in the series will cover the popular Visicalc program.

The Visicalc course is for beginners and intermediate users, the only pre-requisite being that the student has completed and understands the tutorial section of the Visicalc manual. It will be of one day duration and will cover such areas as improved techniques of modelling, graphics and other interfacing and expanded RAM modelling.

Other courses to be announced soon will include Advanced Applesoft Programming, and Introductory Apple Assembly Language Programming, and all will be held at City Personal Computers' new Crows Nest offices. Prices have yet to be finalised but a prospectus is being prepared for all of the courses and will be available from City Personal Computers at the City store, or from the Crows Nest store at 5/385 Pacific Highway, Crows Nest, NSW 2065, telephone: (02) 922 3600.

A&R sells micros

The well known magazine and book retailer, Angus and Robertson has opened Business Centres within twelve of their stores to sell the National Panasonic JB-3000 (Bench-tested elsewhere in this issue). As well as the '3000 the Centres will be offering computer publications, furniture and stationery and also typewriters and calculators.

The A&R Business Centre head office can be contacted in Sydney on (02) 290 1900.

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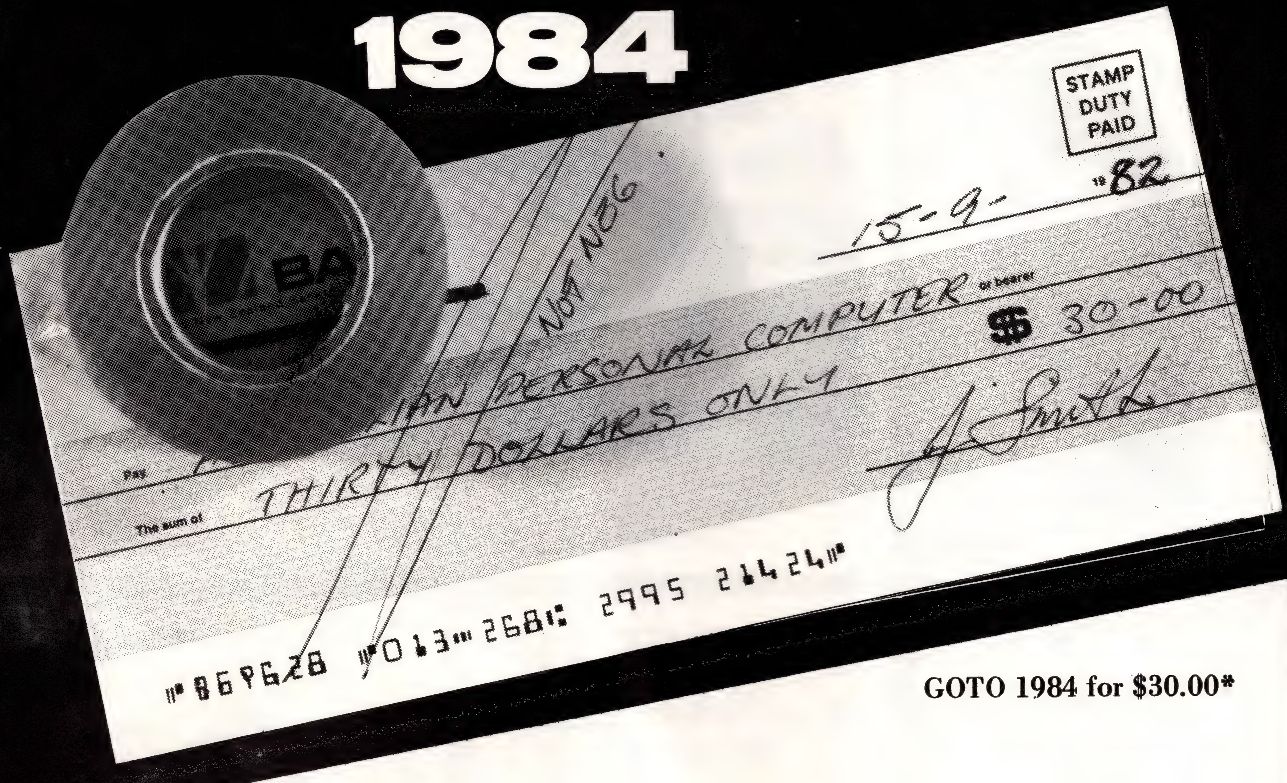

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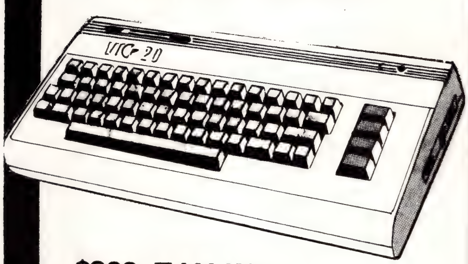

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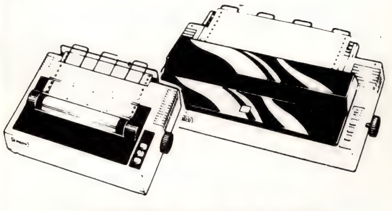

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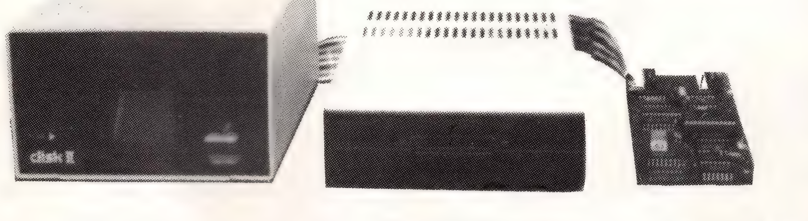

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Part 3

The Translators

Concluding Sue Eisenbach and Chris Sadler's appraisal of the UCSD p-System

The name 'p-System' is a carefully thought out attempt on the part of SofTech to dispel the widely-held idea that 'UCSD' stands for Pascal alone. We hope that the last two articles, describing the structure and philosophy of the operating system, its utilities and applications packages, have shown this not to be the case. This article, however, deals with the different translators provided by SofTech for program development.

The high-level languages offered by SofTech are UCSD Pascal Fortran 77 and Basic. All of these feature compilers which produce p-code object programs. In particular, there is no run-time environment in which Basic programs are directly interpreted. When one decides to develop programs in a particular language, the procedure is to name the relevant .COMPILER and .LIBRARY files as SYSTEM files on the system disk. Commands like R(un will then automatically deal with the source file in the correct language. However it is possible to mix modules written in different languages once they have reached the p-code stage.

SofTech is committed to providing native-code compilers so that the p-code interpretation phase can be by-passed for the sake of speed. To date, however, only the Z80 and 8088/8086 compilers offer this facility. There is also an Adaptable Assembler.

UCSD Pascal

The syntax of UCSD Pascal differs from standard Pascal, having numerous extensions and some omissions. Most users of UCSD Pascal (or the numerous 'look-alikes' — eg, Pascal M, Onyx Pascal, Corvus Pascal) would be loth to give up the extensions although most users look forward to SofTech bringing UCSD Pascal up to the new ISO standard. The manual says it will 'eventually comply with the standard' and it is to be hoped that 'eventually' will err on the side of sooner rather than later.

One glaring limitation is the restriction of the data type FILE to disk-resident files. In standard Pascal, a file is simply defined as a sequence of components, all of the same type, which may be associated with secondary storage and peripherals', but which may equally be entirely memory-resident where it provides an extremely useful structured data-type. Another shortcoming in relation to the standard is the absence of the facility whereby PROCEDUREs or FUNCTIONs can be declared as formal parameters in other procedure or function calls. This is a surprising omission, especially in view of the fact that this same feature is implemented in the underlying p-code. The major areas where UCSD offers extensions beyond the standard are in its string-handling capabilities, its memory management facilities, concurrency and I/O intrinsics.

UCSD Pascal has a pre-declared type STRING which caters for string variables from 0 to 255 characters in length. The length of any particular string can vary dynamically during the program's life, and there is a set of string-handling intrinsics by means of which strings can be manipulated within the program, although it is also possible to perform manipulations using standard Pascal and treating the strings as PACKED ARRAYs of CHARs.

The string-handling intrinsics are:
CONCAT, which accepts a variable number of strings and returns a single (concatenated) string;
DELETE, which removes a given number of characters from a given position in a string;
INSERT, which inserts a given string at a given position within another string;
and POS, which returns the starting position of a given sub-string within a string. Finally, READ and READLN have been extended to cope with string input.

As a language, Pascal was designed for teaching good programming concepts. As such it is frequently somewhat deficient in the practical features needed to get a large, real application program developed and running quickly and without using up excessive amounts of memory — a common problem for programmers on microcomputers. UCSD Pascal tries to take these requirements into account by providing several tools for dealing with large programs. These include the idea of segmentation, whereby object modules within a program can be nominated to remain on the disk at run-time and brought into memory (where they replace other segments) only when required; and the idea of external units — collections of pre-compiled modules which are incorporated into a particular application program during linking.

The keyword SEGMENT is a reserved word in UCSD Pascal which, if placed before a PROCEDURE or FUNCTION, makes the loading of that segment independent of the loading of the main program segment. The segment therefore becomes a candidate for swapping in and out of memory. The run-time system, in general, copes with the interchange of segments but there are two intrinsic procedures, MEMLOCK (for locking a segment into memory), and MEMSWAP (for releasing a locked segment), which allow a programmer to intervene. In addition, it is possible to CHAIN disjointed program segments together.

The UNIT is divided into three sections: an INTERFACE section where all identifiers accessible from outside the unit are declared; an IMPLEMENTATION part where the actual code of the module appears; and a third section which can contain initialisation and termination code; The function of a unit is two-fold — firstly it can be used to store pre-compiled modules during program development, which saves having to compile error-free code over and over again during a particularly intensive debugging phrase. The second (and really more legitimate) application is to use the UNIT to offer users of a particular system a library of useful routines (eg, a graphics package or a statistics library) which they can call on in their own programs simply by including a USES statement in their code.

The 'initialisation and termination' section gives the designer of the unit an opportunity to ensure that the environment in which the modules will execute is the correct one (eg, on a graphics display, the screen is cleared and the cursor is set to a pre-defined position), and that the system is returned to 'normal' when the program completes. Facilities exist within the p-System to construct libraries from one or more units or even to incorporate a unit into the system libray.

Version IV of UCSD Pascal has been extended to allow for the initiation and control of concurrent processes — ie, modules which execute together, sharing the use of the processor. This facility is important, for instance, for the control of hardware devices, and hitherto programmers have had to resort to assembly-language programming to achieve this. Processes are declared like procedures except that the reserved word PROCESS is used; and are initiated from within a program by means of the intrinsic procedure START. A single process may be started more than once and the run-time system divides its attention between all the currently active processes. START takes additional (optional) parameters. one of which is a priority value to influence this division of attention; another is a 'stacksize' to control the amount of memory the process gets.

Interprocess communication is achieved by means of semaphores. A semaphore is initialised by the intrinsic procedure SEMINIT (identifier) where the identifier has already been declared as a SEMAPHORE. The intrinsic WAIT causes a process to pause until a given semaphore is available, while SIGNAL makes the semaphore available. Finally ATTACH is used to associate a semaphore with a hardware interrupt, thus making it possible to do real-time programming in Pascal (ie, via a hardware clock interrupt).

There are low-level I/O intrinsics which give the programmer control over all the peripherals, although they must be used carefully since the increased power increases the vunerability of, for instance, the filing system to programming errors. BLOCKREAD or BLOCKWRITE enable the direct access of logical blocks on disk files and allow rapid handling of arrays. UNITBUSY, UNITCLEAR, UNITREAD, UNIT-

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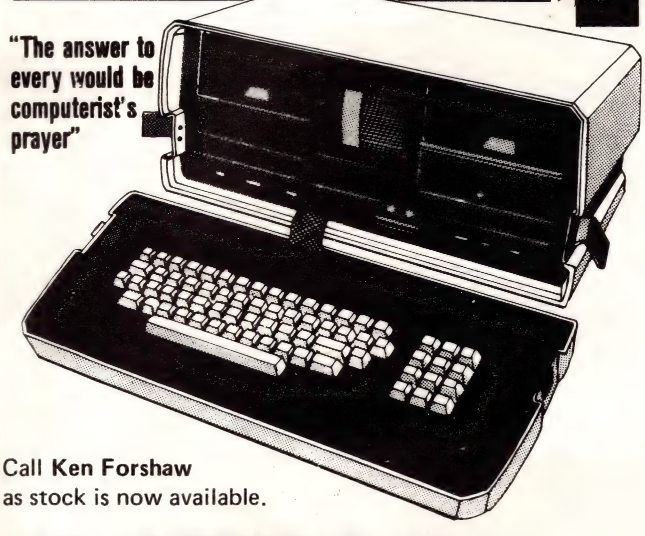

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STATUS, UNITWAIT and UNITWRITE offer the programmer total control of any I/O device on the system from within the program. Finally there is IORESULT which, after any standard I/O operation, returns a value between 0 and 18, reflecting the outcome of that operation. If the automatic I/O checking is disabled, the outcome of I/O faults is left in the hands of the programmer, and IORESULT is the diagnostic which provides a means for producing 'user proof' programs.

High-level I/O diverges from standard Pascal in the inclusion of a file type INTERACTIVE, which is similar to the type TEXT except that the automatic GET during the RESET operation is suspended. The standard files INPUT and OUTPUT are of type INTERACTIVE as is the UCSD 'standard' file KEYBOARD, which is a non-echoing version of INPUT. Most other implementers of Pascal compilers have solved this problem by a technique known as 'lazy I/O' whereby the automatic GET is queued until the first READ is encountered, and subsequent GETs are treated likewise. These different methods of solving the same problem mean that no interactive Pascal program can be moved from UCSD to a standard Pascal system without alteration of the code. Another extension is the provision of a second parameter, the file-name, for RESET and REWRITE. The intrinsic SEEK enables the programmer to reposition the file-pointer and thus allows random access file handling. Finally, the keyword CLOSE allows (through parameters) for the insertion or deletion of file-names from the disk directory.

Other extensions include: a CASE statement which 'falls through' if the selector is undefined; the ability to nest comments; the ability to compare arrays or records (by means of = or ◊; and EXIT, which when encountered causes the immediate termination of the block or program.

Long integers can hold numbers up to 36 digits long and the intrinsic STR serves to convert such numbers into strings for output purposes. PACK and UNPACK are not implemented, although PACKED is, and packed arrays of characters (these are implicit strings) can be manipulated by FILLCHAR, MOVELEFT and MOVERIGHT. The standard files INPUT, OUTPUT and KEYBOARD are always opened when a program begins execution and the program heading declaration is ignored. The implementation of SETs is rather impressive — they may have a maximum of 4080 elements. The intrinsic GOTOXY controls the cursor of the logical device CONSOLE, while REDIRECT and EXCEPTION can be used to enable or disable I/O redirection. Heap space is managed by NEW and DISPOSE, which deal in single records, VARNEW and VARDISPOSE which deal with a given number of words of memory, and MARK and RELEASE which together clear a predefined area in the heap.

Like many other Pascal compilers, UCSD Pascal supports the feature of compile-time options which appear as pseudo-comments somewhere within the text of a program. These include options for: switching I/O checking on and off; switching range checking on and off; conditional compilation of sections of code (useful for debugging); the inclusion of other source files during compilation; the production of listing files; the suppression of normal compiler message output (suitable for slow terminals); and the incorporation of user-defined libraries.

A useful option which has been omitted but which would not be too difficult to incorporate would be a switch which flagged all deviations from ISO Standard Pascal. Using this, a programmer who had developed a program under UCSD could obtain some help with converting the code to standard Pascal before transferring it to run under some other compiler. At a recent USUS conference, Tony Addyman, chairman of the ISO Pascal Standards committee, congratulated the p-System owners on selecting an operating system which made them independent of hardware manufacturers but pointed out that a standard Pascal compiler would make them independent of software manufacturers as well.

Standard Pascal was designed as a teaching language but UCSD Pascal seeks to go beyond this, providing a set of general-purpose problem-solving features and sufficient flexibility to allow most users to program a high-level solution to most problems, be they system, control or conventional applications. When it was originally developed many were sceptical as to whether a usable compiler could be implemented on a microcomputer at all, and UCSD Pascal was regarded as highly innovative. Today new machines and more demanding users make it important that all aspects of the p-System, not least its compilers, should be the subject of a continuous programme of improvement.

Fortran

The Fortran 77 compiler offers a sensible entry into the UCSD p-System for anyone with an established base of (Fortran) software, although the language is not quite as tightly bound to the operating system as is Pascal itself. According to the manual, SofTech Fortran is 'closely related' to the ANSI Fortran 77 standard subset. In fact, two features of the subset are not implemented: namely, the ability to pass function and subroutine names as parameters, and the allocation of equal amounts of storage space to INTEGER and REAL data elements. The compiler will compile standard Fortran IV programs. The compiler is credited to Silicon Valley Software Inc, both in the manual and on screen when the compiler is invoked.

On the other hand, several aspects of the 'full' Fortran 77 definition have been implemented, including the ability to reference array elements and to call functions from within a subscript expression; the ability to use integer expressions as limit specifications in DO loops and implied DO loops or as I/O unit numbers; and the ability to use an arithmetic expression within the I/O list of a WRITE statement or as the value of a computed GOTO. In addition, both random access and sequential files are permitted to be either formatted or unformatted, in line with the full standard.

The compiler supports four directives (a la Pascal), denoted by a $ in column one. $INCLUDE provides the conventional include facility (nesting up to five deep), useful for handling COMMON blocks and other declarations. $USES declares a library file, and $EXT declares an assembly language routine as callable from the code currently being compiled. $XREF produces a cross-reference listing. In addition to the code-file, the compiler will (optionally) produce a listing file consisting of a line-numbered listing which incorporates a procedure-relative instruction counter, and a symbol table. (In fact, the listing file is not as optional as it might be since typing 'n' in response to the question 'Listing file?' results in the production of a data file named 'n' on disk.) Compile-time errors are flagged immediately below the line in which they occur and are referenced by number. There are 186 compile-time errors ranging from 1 (fatal error reading source block) to 405 (read error on scratch file). Those up to 200 are syntax errors; the rest refer to compiler directives or peripheral problems.

The syntax of SofTech's Fortran 77 supports a single main program (optionally headed by a PROGRAM statement) together with an arbitrary number of subroutines and functions, headed by SUBROUTINE and FUNCTION statements respectively. Each of these is termed a 'program unit' and every program unit must be terminated by an END statement. There can be no trailing blanks after the final END statement — if there are any, the compiler tries to compile them! Statements within each program unit must be ordered so that, if they exist, specification statements precede DATA statements, which precede statement function statements, which precede executable statements.

Specification statements include IMPLICIT, DIMENSION, INTEGER, REAL, LOGICAL, CHARACTER, COMMON, EXTERNAL, INTRINSIC, SAVE and EQUIVALENCE. The data type CHARACTER allows for strings with lengths up to 127 bytes; the default length is one byte. These can be manipulated somewhat like other data types (eg, character 'constants' are allowed, assignments and (lexical) comparisons are possible) but no operators act on character variables, and variables of different lengths may not be associated together in EQUIVALENCE statements. INTRINSIC is used to declare all references to the subroutine library within the current program unit. SAVE is used to preserve a dynamically allocated common area when returning from a subroutine in which the COMMON blocks are defined. Since the p-System allocates common areas statically, its use is not necessary in SofTech's Fortran 77 and it was implemented only for sake of compatibility with the Fortran 77 standard.

Fortran 77 expressions are evaluated in the conventional way with normal operator precedence. The result of an integer division is truncated towards zero (ie, rounded down if positive and up if negative). Mixed INTEGER and REAL expressions are evaluated as REAL. Relational operators (.EQ. etc) with operands of like type (INTEGER, REAL and CHARACTER, but not LOGICAL) may be employed. In the case of CHARACTER variables, operators like .GT. exploit the ASCII ordering. In addition to the usual '=' style computational assignment, there is a label assignment statement (ASSIGN — TO —) whereby the value of a variable can be set to an existing statement label number. (This includes FORMAT statement labels.)

Assignments to a REAL variable are, if necessary, converted (ie, if the expression is of type INTEGER) while, in the opposite instance, a REAL expression is truncated to 'fit' into an INTEGER variable. Likewise, CHARACTER variables are padded with trailing blanks or truncated when a length mismatch occurs on assignment.

Control statements include unconditional, computed and assigned GOTOs, arithmetic and logical IFs, the IF — THEN — ELSEIF — THEN. . . ELSE — ENDIF construct, together with DO, STOP, PAUSE, CALL and RETURN. The Fortran IV type constructs (ie, the GOTOs) may not jump into blocks of executable statements. The DO loop is tested at the top, in contrast with Fortran IV which tests at the bottom of the loop so you always get one pass through the block.

STOP and PAUSE can be used to halt execution and both can take an argument (INTEGER or CHARACTER) which will be printed on the console when the statement is executed. In the case of PAUSE, execution is recommenced when a key on the keyboard is pressed. In functions and subroutines RETURN transfers control back to the calling routine — however, the terminating END statement performs the same function, so anyone who believes that subroutines should have only one exit can dispense with the RETURN altogether.

SofTech Fortran 77 formatted records are constructed as character strings consistent with external p-System operations. This means, for instance, that a file of formatted records can be read by the system editor, and that formatted data files are portable from one p-System to another. No such guarantees exist for unformatted records which employ machine dependent internal representation. The symbol '*' can be used as a unit number in READ and WRITE statements, denoting the device CONSOLE. I/O statements include OPEN, CLOSE, READ, WRITE, BACKSPACE, ENDFILE and REWIND. OPEN has four optional switches, as follows:

STATUS = NEW/OLD
ACCESS = SEQUENTIAL/DIRECT
FORM = FORMATTED/UNFORMATTED
and RECL = record length; while CLOSE has STATUS = KEEP/DELETE.

Random access is handled by including a REC=⟨record number⟩ field into READ and WRITE statements. All the normal format specifiers are permitted and in addition the ' ' (backslash) symbol serves to suppress the automatic CRLF so that interactive screen I/O can do question and answer on the same line. Logical (L) format accepts (on input) and produces (on output) the abbreviations T and F for .TRUE and .FALSE. .

Table 1 shows the intrinsic functions

Basic

When we first thought of writing this series of articles we arranged for SofTech to send us one of the first Version IV p-System Basic disks. It was some considerable time before we actually got round to trying it out and we found that the compiler crashed on even the most trivial (ie, two line) Basic program. At the next USUS conference we buttonholed Jean Gianetta of the SofTech sales team, who confessed that early releases of the Basic had had problems, especially on the LSI-11 interpreter. She duly sent us a subsequent version which works. What surprised us, though, is that we had not heard a word about any such problems on the USUS grapevine, from which we are forced to conclude that p-System users, faced with Pascal, Fortran 77 or Basic tend to choose one of the first two.

The second surprise was that the p-System Basic dialect does not show any signs of being influenced by Pascal. The table of Basic reserved words implemented in SofTech Fortran shows what the syntax is like. There is a full range of string handling functions and special I/O features for handling functions and special I/O features for handling, for instance, money input data. Programs can be split up into libraries and subroutines with parameters and local variables. Like most compiled Basics, p-System Basic doesn't require line numbers to be in ascending numeric order, or even to exist at all. Each instruction is terminated by carriage return, which implies only one instruction per line, although it is possible to suppress this by enclosing the CR in Pascal-type comment delimiters. There are several compiler directives which, for example, turn I/O and range checking off, or switch to handling transcendentals in the library in 'a manner consistent with Texas Instruments machines'.

What with this cryptic remark and a few other odd things (eg, the command DISPLAY to write to the screen) we were curious as to where this dialect of

Type Conversion	INT, IFIX REAL, FLOAT ICHAR CHAR
Truncation and other Numeric Manipulation	AINT, ANINT, NINT IABS, ABS MOD, AMOD ISIGN, SIGN IDIM, DIM
	MAX0. MAX1, MIN0, MIN1 AMA0, AMAX1, AMIN0, AMIN1
Transcendentals	SQRT EXP ALOG, ALOG10 SIN, COS TAN ASIN, ACOS ATAN, ATAN2 SINH, COSH TANH
Lexicals	LGE, LGT LLE, LLT
End of File	EOF — returns TRUE or FALSE. (not standard Fortran 77)

Table 1 Fortran intrinsics

BENCHMARK TIMINGS

	UCSD Basic
BM1	1.3
BM2	1.5
BM3	2.6
BM4	4.0
BM5	4.2
BM6	11.4
BM7	15.7
BM8	5.1

All timings in seconds. For an explanation and listing of the Benchmark tests, see APC Vol 3 No 8, September 1982.

BASIC RESERVED WORDS

CONTROL FLOW CONSTRUCTS

GOTO
ON—GOTO
IF—THEN—ELSE
FOR—TO—STEP NEXT
GOSUB
RETURN
ON—GOSUB
LET
STOP
END — must exist at the end of a program;

▶

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DEF [function type] function name [(parameter list)];
FNEND — necessary to end multi-line functions;
SUB subroutine name [(parameter list)] — starts a subroutine;
SUBEND — last statement in a subroutine;
SUBEXIT — terminates a subroutine call within a subroutine;
CALL subroutine name [(parameter list)] — calls a subroutine;
UNIT unit name — must exist at the start of a Basic program or subroutine that is to be compiled seperately and linked into a larger program.

I/O RESERVED WORDS

PRINT — sends output to printer;
DISPLAY — directs output to screen (like most Basics' PRINT);
ERASE ALL — clears the screen;
AT (line number, column number) — positions cursor at the specified place on the screen;
BELL — rings the bell;
USING — controls formatting in DISPLAY, PRINT and ASSIGN statements;
IMAGE — provides a format for a USING statement;
PUNCTUATION — allows the altering of monetary symbols for currency symbol digit separators and decimal points;
INPUT — can be used with AT, BELL, SIZE (max length acceptable for a given string) or a quoted string so that it can provide output as well as input);
ACCEPT — similar to INPUT except that it reads entire input into one string variable;
DATA
READ
RESTORE — repositions a file pointer and reinitialises a DATA statement;
INKEY — always returns 0;
INKEY$ — returns the next character frpm the keyboard buffer;
INTERNAL — binary format for a file;
REC — accesses an INTERNAL file record;
RELATIVE — random access file;
SEQUENTIAL — sequential access file;
OPEN — for files;
CLOSE — for files;
UPDATE — default mode for opening files, allows reading and writing;
APPEND — only allows writing to the end of the file.

ARRAY RESERVED WORDS

ASSIGN — associates a virtual array with a disk file;
DIM
OPTION BASE — used to set base index of an array, eg, to 1.

STANDARD FUNCTIONS
ABS
SIN
COS
TAN
ATN
EXP
LOG
INT
SGN
SQR
RND
RANDOMIZE
ASC — returns the decimal value of the first character in the string argument;
BREAK — finds the first character in a string that appears in a second string;
SPAN — compares characters in a string;
NUMERIC — returns —1 if string is a valid number and 0 otherwise;
VAL — returns numeric value of a string;
STR$ — returns a string given a numeric value;
POS — returns the position of one string in another;
RPT$ — returns a string which is a specified number of repetitions of the argument string;
UPRC$ — change all lower case letters to upper case;
CHR$
SEG$ — extracts a substring from a string;
DAT$ — returns month/day/year;
TIME$ — retuns hour/minutes/seconds;
FREESPEACE — returns number of free bytes;
EOF — returns 0 if not at end of file and a positive number otherwise;
FTYPE — returns 0;
TAB — loves to a tab position in a PRINT or DISPLAY statement;
ERR — returns an error number (0 if no error).

Table 2

revealed that TI had commissioned SofTech to produce a version of its Business Basic.

Native code generation

Z80 and 8086 processor based p-Systems can take advantage of native code (n-code) generators. Since these accept p-code files as source, programs written in any high-level language can be rendered into n-code. In general, native code generation will be limited to specific procedures or functions within the high level source code which are bracketed by compile-time switches (ie, ($N+) and ($N—). Any assembly language routine referenced within such a procedure must be linked in before the code-file is submitted to the native code generator. Users looking for speed, therefore, have a fairly flexible regime — they can code in a high-level language for convenience, compile to native-code for the more crucial routines and finally hack out the assembler themselves for the bits which they absolutely cannot leave alone.

Conclusion

When it was first conceived as a university teaching project, the UCSD p-System was a realisation of some innovative ideas about Pascal on microcomputers, portability and the functionality of microcomputer operating systems. These features are not only available to all of us through SofTech's Version IV p-System, but are also being pursued by many software companies who have been influenced by the original San Diego project.

As users of microcomputer systems who employ the p-System both at home and at work, equally for its power, its portability and its ease of use, and who have found information, enlightment and entertainment in its user community USUS, we can recommend the p-System for serious consideration by all microcomputer users.

END

'I'm sorry, Gerald, I can't see you anymore, the computer at work thinks you're pathetic.'

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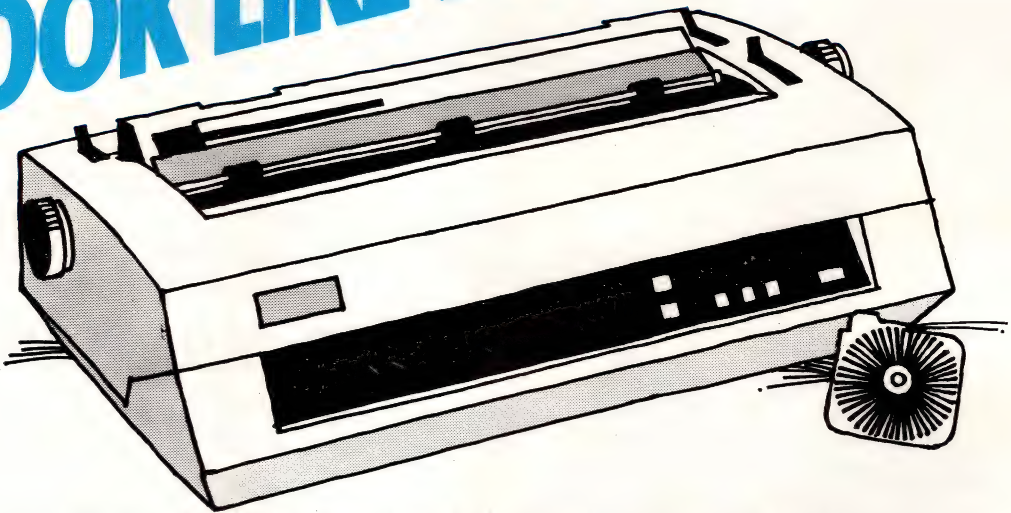

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STEREO GRAPHICS!

Paul Stevenson outlines a neat and novel way to get 3-D on a micro

Now that high resolution colour graphics, in various forms, are becoming available in small computers the possibility exists of generating the traditional red/green image pairs necessary to produce a three-dimensional stereoscopic image when viewed through a pair of spectacles with a red filter over one eye and a green over the other.

The geometrical theory behind the positioning in the red and green parts of the image will be given and one example program included. Finally, possible applications are considered.

Consider first the red and green images which would have to be produced on the page of a book to give the image of a pyramid standing vertically from the page when viewed from 45 degrees. (see Fig 1). This example is chosen because it works particularly well and because the programming is particularly simple when it is later transferred to a VDU screen.

Assume that eye L is to view through a green filter and that eye R looks through a red one. The desired final image is shown in black WXYZA. The eyes are taken as being 6 cm apart. Since a red line on a white ground should not be visible through a red filter and should appear black through a green one and a green line will similarly not be visible through a green filter but will appear black through a red filter, the images of the intended pyramid as seen by each eye separately can be extrapolated back to lines projected onto the horizontal surface as shown. In fact, for simplicity, the only point in the example which needs extrapolating is the apex of the pyramid A, if one assumes that the base of the pyramid lies in the plane of the page. This gives projected points GA and RA as seen by the right and left eyes respectively. Thus all that has to be done to define the green image on the page (screen) is to join GA to the points WXYZ. The red image can then be joined up in a similar manner. In the example the red and green images are symetrically placed with respect to the centre line but this need not be so for other objects.

Fig 2 shows the final appearance of the images on the screen or page. Note that around the base WXYZ, where both red and green images overlie each other, the line should be plotted in black since it has to be present at *both* eyes. The final image received by the brain is in monochrome. Some microcomputers make provision for making the logical AND function of the plotted red and green colours equate to black and this is a distinct advantage in the programming.

Fig 3 shows the viewing situation for the example program — it was arranged this way because the final pyramid was required 'correct way up'. (There are other ways of achieving this with the VDU arranged conventionally but the geometry is much harder to explain.) The effect is very powerful if the filters are closely matched to the colours on the screen (more on that later).

Having decided to replace the page with a VDU screen placed horizontally then essentially all that one has to do is to decide on:

a) the size (centimetres) of the pyramid base;
b) the height of the pyramid;
c) the viewing distance and angle (50 cms and 45 degrees in this example);

a) and b) are both variables presented to the program.

What remains in to calculate the screen coordinates of WXY and Z and of the points GA and RA. This involves only simple ratios in similar triangles. At a late stage in the program the position of points GA and RA will have to be converted from centimetres to plottable screen points. This conversion will depend on the resolution of the graphics employed but in the machine I used this conveniently works out on both axes at about 55 points per centimetre.

The program is listed in Fig 4 and as far as possible it has been kept to a common subset of Basic. For instance, no graphics offset origin or procedure calls been used, both of which would have simplified the code.

Extensions to the program

The following extensions to this simple program are possible if there is a drive to experiment.

First offset the apex of the pyramid relative to the base. Secondly raise the base itself itself off the actual screen. The latter task involves calculating the red and green image positions for all four corners of the base as they will not now overlie each other. The pyramid can now be made to appear suspended above the screen surface (yes it does work) but the height it appears above the screen surface is limited by the screen size you are using — the images start to plot off the top of the screen area if it is raised too high.

A third possibility is to experiment with the viewing angle, but this has not been tried yet. In relation to this, to avoid the silly situation of a VDU monitor lying on its back, a 45 degree viewing angle can be obtained with the VDU in its 'normal' position but with the view standing 45 degrees 'above' the screen. This is more convenient for viewing — the images are plotted 'down the screen' — GA and RA are near the bottom, but the pyramid 'sticks out' towards the keyboard (not so useful for teaching). Talking about teaching use — here is a snag! The effect can only be seen well by one or two people at a time. There appears to be considerable latitude in both viewing distance and angle of view before the effect disappears altogether but at non optimal positions the pyramid is 'distorted'.

Depth illusions

A program has been experimented with, whereby a framework cube is made to appear suspended in the space between the viewer and the screen (see Fig 5).

With appropriate image placing on the screen, the cube can be made to appear, say, halfway between the viewer and the screen. Using the same type of geometry as before the projections of the cube corners onto the screen from each eye can be calculated and then plotted. The effect works but it is (or appears) more difficult to 'conjure up' as it needs the eyes to be focused on empty space at the halfway point where there is nothing there to start with. The main source of light — the screen — acts as a distractor. If the image is on or near the screen everything appears to work much better.

This program has, as input variables,

Lines 40 and 50	fix the pyramid height and base in centimetres.
Line 60	sets a variable to half the base length. The 55 converts from centimetres to screen units.
Line 100	selects the appropriate graphics mode (four colours)
Lines 110 to 116	sets the colours to red and green, with a white background for the graphics.
Line 130	clears the graphics area to its white background.
Line 140	calculates the length of GA to 0 (Fig 1) in cms. The 40.11 is the length of OT (one could almost use 40 cms).
Line 150	calculates the displacement left of the centre line for the point GA in screen units this time.
Line 160	calculates a similar displacement up the screen.
Line 410	choses colour green.
Lines 420 to 510	draws the green image.
Line 655	since the green and red images are symmetrical this sets the displacement right of the centre line for RA. (DU is the same as before.)
Line 660	The clever one! This choses red to plot unless the colour already there is green in which case it draws black. This will make the red/green overlap areas the correct colour.
Lines 670 to 760	plots the red image.
Line 998	waits for any key before restarting.

Program explanation — see fig 4.

the distance of the desired cube from the eyes, its size, and its angle to the horizontal.

Images behind the screen

The principle here is the same as in a) but beware — the relative placings of the red and green images are reversed left for right.

Fig 6 should make this clear and illustrates how a frame cube could be made to appear *inside* the VDU tube. Beware of this red/green reversal effect if you have an object which you wish to intersect the screen. The same difficulties about distraction during focusing apply as in a) — the light from the screen has to be ignored as far as possible.

Selection and rotation of objects

For trial purposes select simple objects. Each corner on an object has to have a projection calculated onto the image plane, and the fewer there are the better. Leave a scale model of the Starship Enterprise till later!

Rotation has been tried with the cube revolving in space between viewer and screen but Basic is too slow to get a nice effect — machine code must be used here.

Practical points

The matching of the filter material bandpass to the intensity/depth of the colour red or green is important. Through even the best red filter some vestige of the red line will be visible on the screen. Reducing overall screen brightness seems to help here. The relative 'blackness' of each colour when viewed through its opposite colour filter should be the same. If one is black and

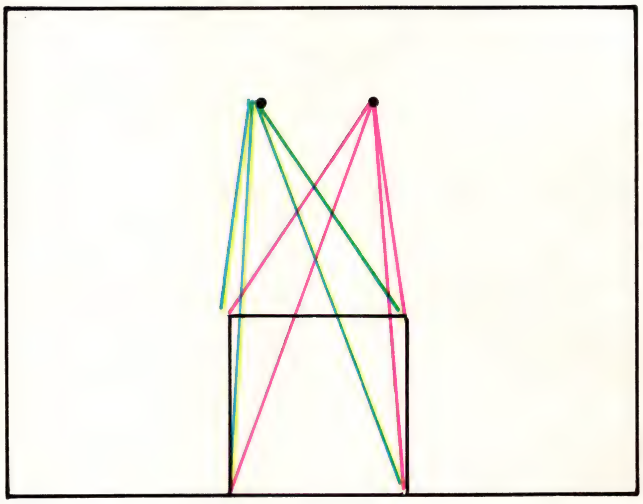


Fig 2. Final images as they appear on the screen or page.

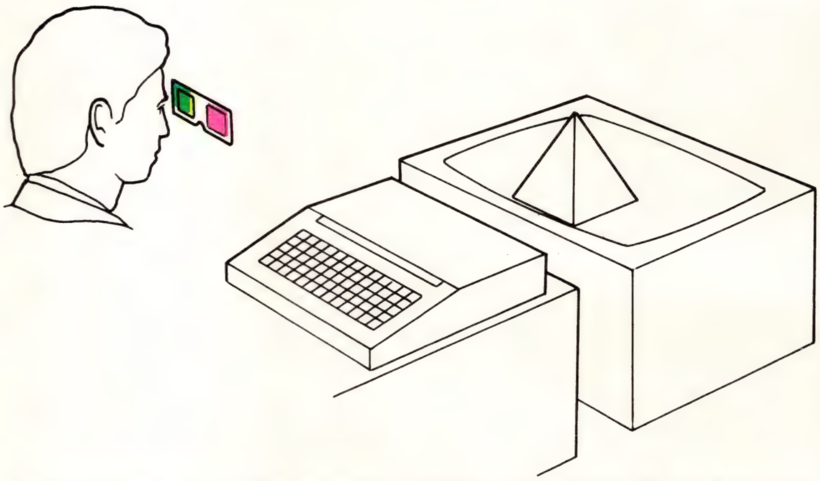
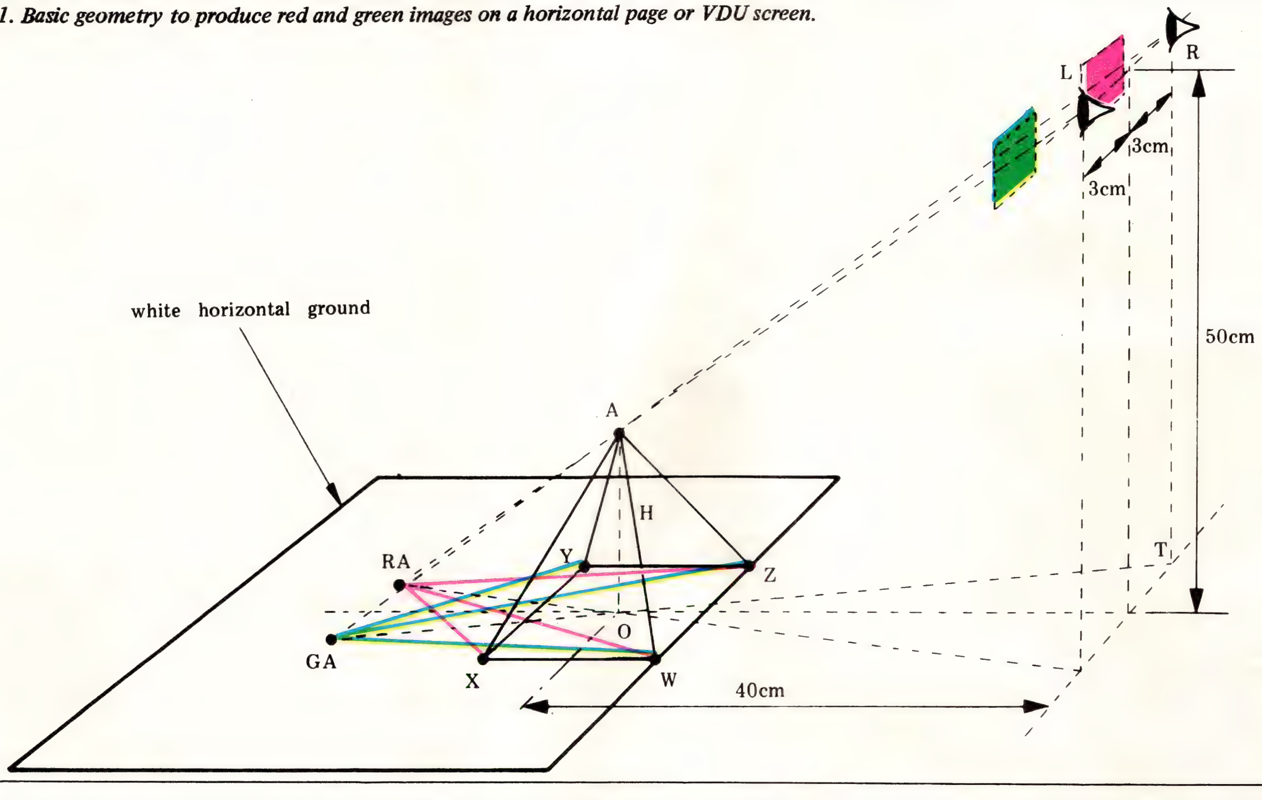


Fig 3. Viewing situation for the example program (put feet on the back of your VDU!!).

Fig.1. Basic geometry to produce red and green images on a horizontal page or VDU screen.



the other a shade of grey the brain will not properly 'pull' the stereo image into the middle and one of the red or green images will dominate.

This is where a facility to 'mix' ones own 'shade' of red or green is very valuable. One then accepts whatever filters one can get hold of and fiddles with the colour mix. This is more elegant.

Wire frame models have been used so far as they do not involve the 'hidden line algorithm'. We now have a need for a hidden line algorithm in three dimensions before real objects can be shown. Who will try?

Although rotation of whole objects is slow it is possible to make a shape 'grow' an extension or 'arm' from a fixed base, and on my first example of the vertical pyramid I have had a small 'character' climb one of the sides 'out' of the screen – hurrah for programmable characters!

The ideal to aim for is to have a program which will ask for the coordinates of all corners of an object (or read them from disk if they have been prerecorded) and a statement about how they are to be joined up and scaled along differing axes if necessary. The program should then request the required position of the object and the viewer and then procede to plot it on the image plane. This is still some way off as a general package for a wide class of objects.

Conclusion

The impact of seeing one's first stereo 'object' emerging from the screen is immense. I do encourage you to try. To whet the appetite, how about the following developments for the future?
Computerised chess with graphics-generated 3-D pieces (remember the horizontal screen/board in Fig 1).
'Star Trek' and similar games chasing Klingons 'through' the screen into the distance instead of across it.
'Adventure' type games in genuine 3-D mazes.
Maybe with machine code in a dedicated ROM these are not too far off!

On a more prosaic level, and with more educational content, how about:
'Contour' maps in geography.
Three-dimensional graphs in any setting.
Technical drawing projection work – make third angle projection drawings 'come to life'.
Three-dimensional geometry and trigonometry teaching.

This list is probably only scratching the surface but to deflate enthusiasm for the technique a little there is still a need for a convenient or quick way of projecting curved objects onto the screen. Circles are okay, but other curves are more difficult – or are they?

I would like to hear from readers who successfully try these techniques or extend them.

```
10   REM 3-D PYRAMID P.W. STEVENSON
40   INPUT "PYRAMID HEIGHT (CM)" H
50   INPUT "LENGTH OF BASE (CM)" B
60   D = B*55/2
100  MODE 5
110  VDU 19,2,3,0,0,0
112  VDU 19, 131,0,0,0,0
114  VDU 19,128,7,0,0,0
116  VDU 19,130,2,0,0,0
130  CLG
140  X = H * 40.11/(50 – H)
150  DL = 3 * X * 55/40.11
160  DU = 40 * X * 55/40.11
400  REM GREEN IMAGE TO RIGHT EYE
410  GCOL 0,2
420  MOVE 640 – D,0
430  DRAW 640 – D, 2 * D
440  DRAW 640 + D, 2 * D
450  DRAW 640 + D, 0
460  DRAW 640 – D, 0
470  DRAW 640 – DL, D + DU
480  DRAW 640 – D, 2 * D
490  MOVE 640 + D, 0
500  DRAW 640 – DL, D + DU
510  DRAW 640 + D, 2 * D
650  REM  RED IMAGE TO LEFT EYE
655  DR = DL
660  GCOL 1, 1
670  MOVE 640 – D, 0
680  DRAW 640 – D, 2 * D
690  DRAW 640 + D, 2 * D
700  DRAW 640 + D, 0
710  DRAW 640 – D, 0
720  DRAW 640 + DR, D + DU
730  DRAW 640 – D, 2 * D
740  MOVE 640 + D, 0
750  DRAW 640 + DR, D + DU
760  DRAW 640 + D, 2 * D
998  INPUT T$
999  GOTO 40
```

Fig 4.

Reference:- *Descriptive Geometry with 3-D Figures* Imre Pal, Hungarian Technical Publishers 1965.

END

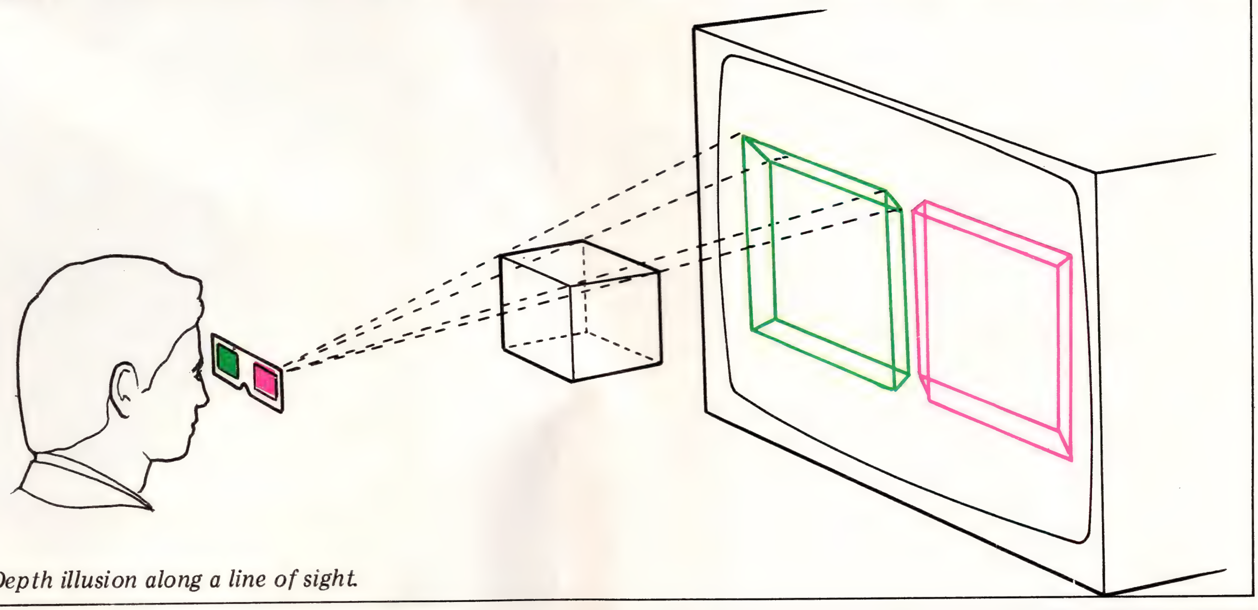


Fig 5. Depth illusion along a line of sight.

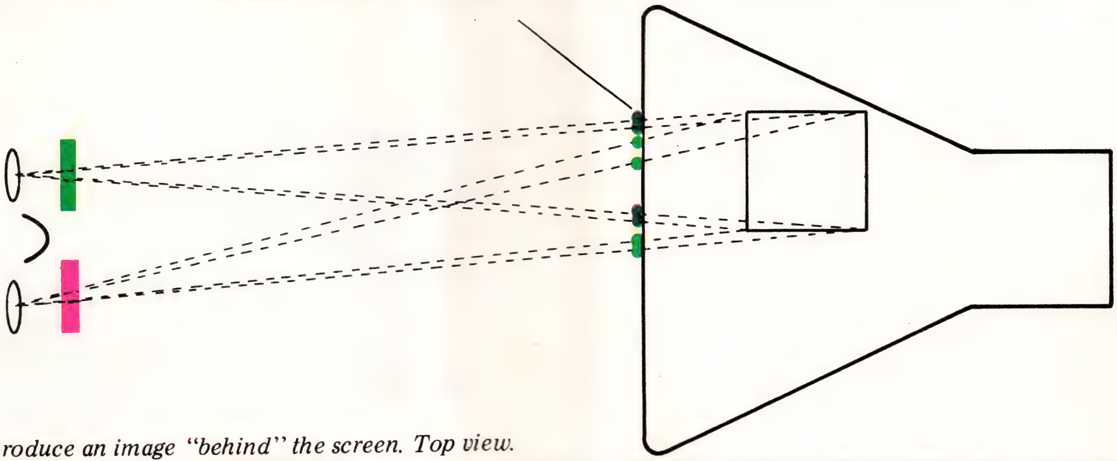
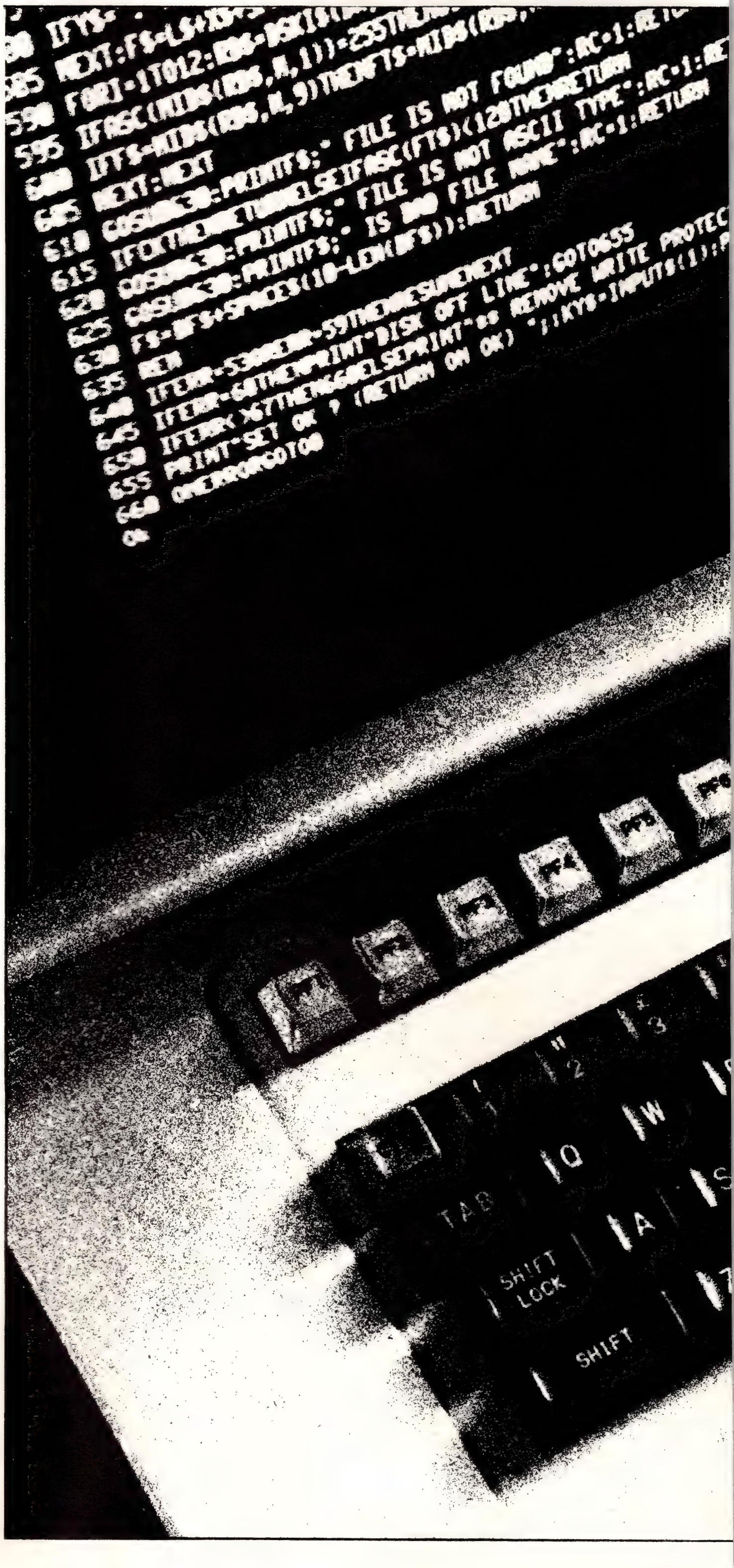


Fig 6. To produce an image "behind" the screen. Top view.

THERE'S NOTHING LIKE GETTING YOUR HANDS ON IT!



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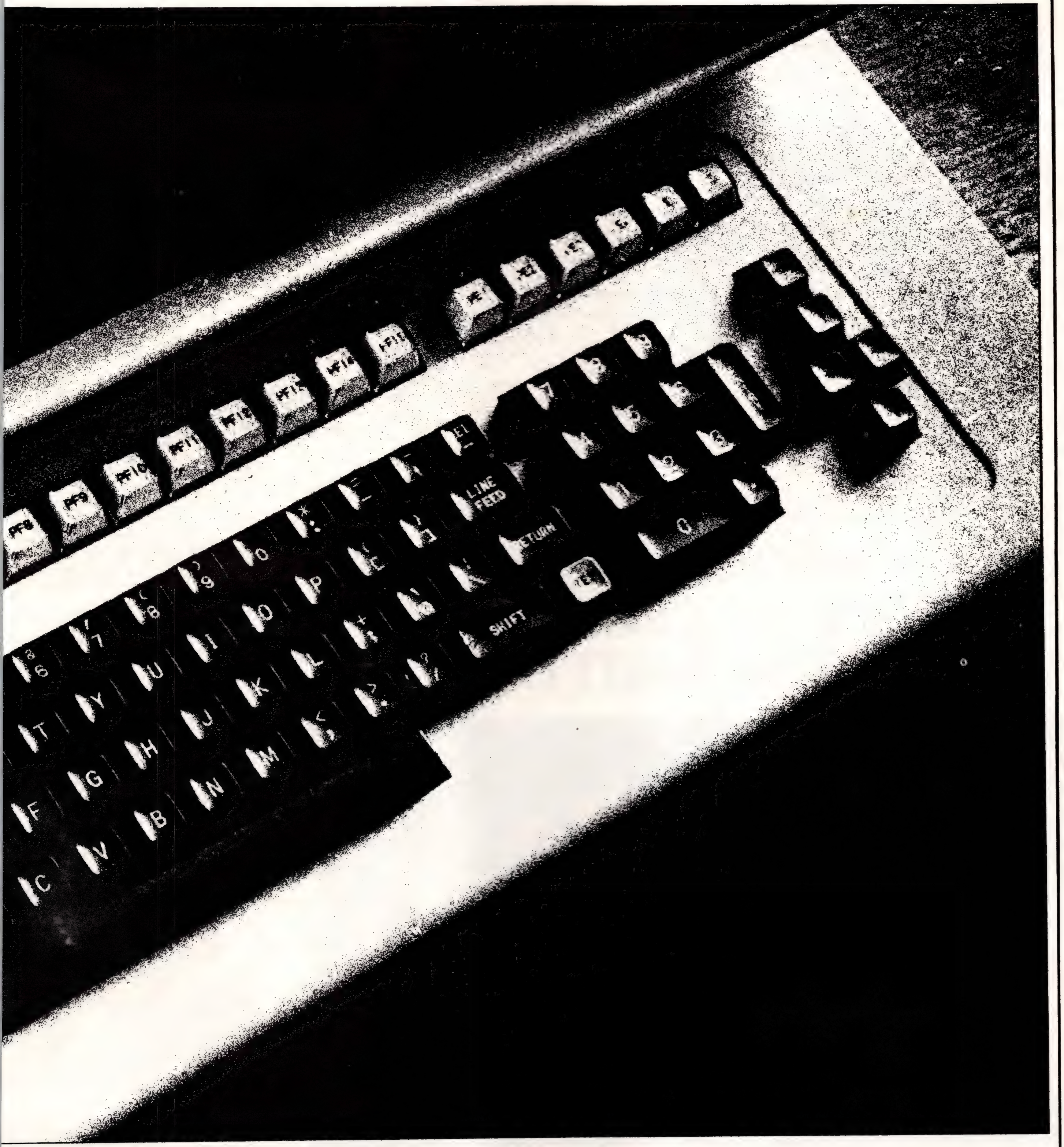

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MS-DOS v CP/M-86

Peter Rodwell compares the two operating systems which — at the moment at least — are fighting it out for supremacy in the 16-bit market

Right now the business micro market is dominated by twin disk, 8-bit computers running CP/M as their operating system. In fact it's fair to say that CP/M, more than any other single development, has enabled business microcomputing to develop at the pace it has. By providing a standard environment which is easily adaptable to any machine with a Z80, 8080 or 8085 processor, more than 16 kbytes of RAM and at least one disk drive, it has brought order to what could otherwise quite quickly become a very chaotic situation indeed.

CP/M-80 (as we must call it, now that there's a 16-bit version), enabled programmers to produce standard software packages which could be guaranteed to run on any CP/M-80 micro. Hardware manufacturers have been able to produce machines more easily, confident in the knowledge that there was an 'industry standard' operating system which could be placed on their micro and would immediately allow buyers to choose from a wide selection of packages. The design of a Z80, twin-disk CP/M machine is now so easy that it's possible, with mass-production techniques, to churn them out in large quantities at exceptionally low prices, even with a bundle of standard software thrown in — witness the Osborne 01 at $2500.

Originally CP/M was written for the Intel 8080 chip, as its creator, Gary Kildall, was closely associated with Intel at the time. By happy chance (well, actually, it was more than chance but I'm sure Kildall didn't predict it), Zilog produced a more powerful microprocessor chip, the Z80, which incorporated the 8080's instruction set as a subset of its own, more powerful set. Thus programs written for the 8080 could run without modification on the Z80, although Z80 programs cannot necessarily run on the 8080 unless they are confined to using only the 8080-compatible instructions and make no use of the Z80's more powerful features.

Kildall wrote CP/M-80 primarily as a software development aid; at that time personal computers were unknown and microprocessors had only just made their appearance. Designs for personal computer systems soon began to appear in American electronics magazines, however, and it was quickly realised that CP/M-80 offered tremendous advantages when used as the operating system for these machines; it meant that pioneer computerists could easily exchange software for a start and, not surprisingly, it didn't take long for people to start producing small business machines, running CP/M-80 and using the standard packages being churned out by the escalating microcomputer software business.

Interestingly, the most successful 'big three' microcomputer manufacturers — Apple, Tandy and Commodore — earned their success quite independently of CP/M-80. Apple and Commodore had no choice because their machines were based around the 6502 chip, which is totally incompatible with the 8080/Z80 family; they each developed their own (incompatible) operating systems instead. Tandy chose the Z80 for its TRS-80 range but went its own way with its own operating system, which, naturally, was incompatible with anyone else's. The 'Big Three' succeeded because they got into the market quickly with good, well-made systems which were easier to use and cheaper than most of the hobby-based systems.

Since those early micro days, the situation has of course changed. Exact figures are very hard to come by in this business but it's fair to say that the Big Three together have about a 50 percent share of the business market while CP/M-80 machines have taken the other half. The number of software packages available for CP/M-80 systems is staggeringly huge and ranges from system utilities through language compilers and interpreters to all sorts of applications packages.

When 16-bit microprocessors appeared, everyone realised that the industry was heading for a rather awkward situation. A vast user base had been established and a massive range of (mostly) well tried and tested standard software was available. But none of the three important 16-bit chips — the Intel 8086, the Motorola 68000 and the Zilog Z8000 — could run any of this software; not even Zilog had had the consideration to make its new heavyweight code-compatible with its old success, the Z80. So all that standard software, into which a lot of money had been poured and with which hundreds of thousands of users were familiar, wouldn't run on the new machine, and neither would CP/M-80 itself.

Clearly the industry had to come up with a new standard operating system so that software producers could get down to converting their packages and users could get their hands on the new generation of machines. But as the three 16-bit chips all had totally different, incompatible instruction sets, no operating system could be adopted as a standard until it was known which chip was going to lead the field.

At this stage in the game, Digital Research (the company founded by Kildall once he realised he was onto a good thing with CP/M-80) was in a very powerful position. There are operating systems which can be run on any machine and for which programs can be written that are totally transportable. One such is the UCSD p-System (read about it in the last three issues of *APC),* in which only a small central core needs to be written in the 'native code' of the processor involved; all programs are written in a high-level language, typically Pascal, and compiled into an intermediate code, p-code, which is translated into native code as the program is run by the central core. But a whole generation of microcomputer programmers have been weaned on CP/M-80 and are familiar with its innards. To convert CP/M-80 packages to a totally alien environment would have been expensive and time-consuming. These people looked to Digital Research to provide as familiar 16-bit environment as possible so that conversion involved a straight translation of assembler souce code plus a few other tweaks, rather than the entire restructuring that an alien environment might require.

The difficulty was to know which processor would be the favourite with hardware manufacturers. The Zilog Z8000 was an early front-runner but hardware makers were put off when AMD decided not to second-source the chip (a decision it recently reversed); no manufacturer wants to base a product around a chip coming from a single source because he'll be high and dry if that source disappears — and despite the success of the Z80, Zilog has never managed to run at a profit.

That left the 8086 and the 68000. Chip buffs are unanimous that the 68k is the more powerful of the two but legend has it that when Digital Research went knocking on Motorola's door, asking for 68000 details because they wanted to write the new CP/M for it, they found that nobody at Motorola had even heard of CP/M-80 and they were gently but firmly shown the exit. Whether this is true or not I don't know and neither have I ever been able to find out exactly why Digital opted for the 8086. But go for the '86 they did, and produced CP/M-86, even though nobody seemed too interested in using it in a real system.

One factor which may have tipped the scales was a new microcomputer from a company which, while unknown in the micro world, had been doing quite nicely in the world of big computers. The long-awaited, long-heralded, murch-speculated-about IBM Personal Computer turned out to be based on the Intel 8088, a 'sawn-off' version of the 8086. (Internally it's a 16-bit processor but it addresses memory as 8-bit bytes rather than as 16-bit words, which is what the '86 does; it is, however, code-compatible with the 8086.)

Meanwhile, with the sort of arrogance a big company accumulates when it's three-quarters of the way to dominating the world, IBM felt that a CP/M operating system wasn't quite good enough and chose a Microsoft product instead, calling it PC-DOS. But Digital Research produced CP/M-86 for the IBM machine anyway and other

MS-DOS v CP/M-86

manufacturers, figuring that IBM would be a safe bet to imitate, began work on 8088 and 8086-based computers. Microsoft, too, realised that if PC-DOS was good enough for IBM it should be good enough for the rest of the microworld and released its 16-bit operating system to us all, under the name MS-DOS.

Thus, as more and more 16-bit systems appear, we can detect a distinct leaning towards the 8086/8088 family and towards CP/M-86 and/or MS-DOS. The Sirius 1 is already here, the National Panasonic JB-3000 is Benchtested elsewhere in this issue, Hitachi's 16-bit micro will be released in Australia this year and at least half a dozen Japanese 'IBM lookalikes', using one or both of these operating systems are on their way.

Before I look into MS-DOS and CP/M-86 in detail, though, I think a few words on the subject of operating systems as a whole are in order.

The perfect operating system

There is, of course, no such thing as the perfect operating system. For reasons which totally escape me, operating systems, like programming languages, religion and politics, seem to inspire quite ridiculous degrees of fanaticism, frequently bordering on bigoted blindness, if some of the hate-mail we receive here is anything to go by. (I cannot understand why anyone should get so upset about a subject like operating systems, which, in the global scale of things, are pretty insignificant — but people do.)

Before microcomputers appeared, computers were large, isolated machines tended by highly-trained people — programmers, operators and so on — who, because they were highly trained, were able to make sense of the arcane jargon and terminology which surrounded the machines. It mattered little that the man in the street was totally mystified by the whole business because no ordinary men in the street ever came anywhere near a computer.

Microcomputers have changed all that. Not only are they appearing on desktops in every conceivable kind of business, but they are flooding homes as well, now that anyone with $200 to spare can buy a computer. Most of the people who are now using personal computers in their work places have no computing knowledge or experience and neither do they want to become computerists: the modern business personal computer is a tool, purchased to improve business efficiency and make life easier. Within three years' time, businessmen will walk into their local business equipment shop to buy a computer in much the same way as they now buy a typewriter or photocopier; they will have a business problem of some sort and will be looking for a piece of equipment which will help solve that problem.

The average businessman simply does not want to have to learn about *computers*; he wants to know which software will do the job he wants done, which piece of hardware will run that software properly and that's all, basically. All he wants to do then is to buy the system, plug it in and get down to work with it. Anything which prevents his doing exactly that is an obstruction, an inconvience and a disincentive for him to get involved with computers at all.

When he sits down to operate his computer, the businessman has three 'levels' at which he could come across problems. Firstly there's the hardware. These days, it's possible to make this pretty foolproof, with the only specialised knowledge being confined to knowing how to turn the machine on, how to put in a disk and how to look after floppy disks correctly. Then there's the applications package he wants to run. Early business packages for micros were pitifully awful, requiring careful use to avoid crashing, demanding rigid syntax and being accompanied by unreadable documentation. Slowly this situation has changed, as software writers realise that their products are being used by computer-naive people who will never understand phrases like 'default back-up store' or who will always accidentally type a letter of the alphabet when they should be typing a number. Gradually we are seeing packages which isolate the user from the bits-and-bytes end of computing and actually cope with mistakes in a helpful and useful way. Documentation, too, is improving, although horrors still abound — take a look at a Wordstar manual and you'll see what I mean.

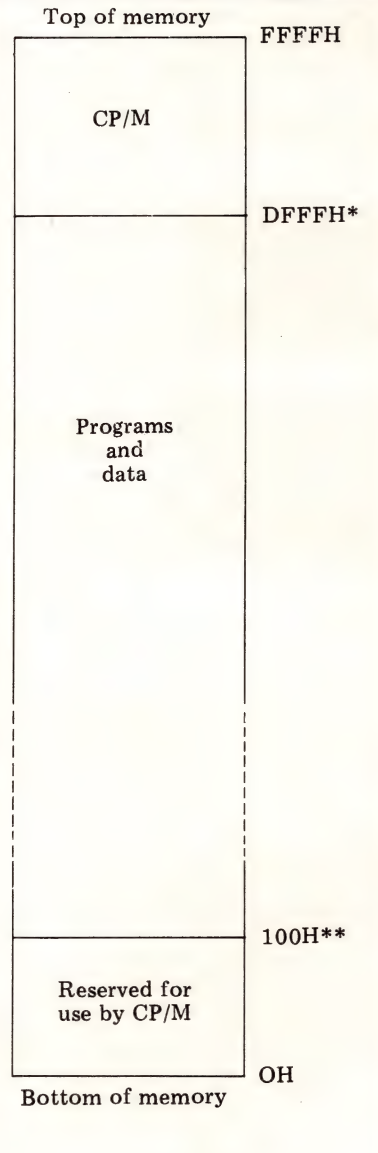
But although considerable steps are being taken to make both applications packages and their documentation user friendly, it's important to realise that operating systems, too, need to be just as friendly and easy to use. When he sits down in front of his computer, the businessman needs the maximum amount of help to achieve his goal; he should not have to wade through pages of instruction manuals in order to understand how to work the machine and he should not be required to learn any special vocabulary before he can make the machine do something sensible. The operating system should enable him to get his application program running as quickly as possible and allow him to carry out whatever 'housekeeping' jobs he has to perform (formatting new disks, taking back-up copies of files, etc) with ease.

Operating systems in the micro world have thus to fulfill two distinct — but by no means mutually exclusive — roles. They must firstly enable software houses and programmers to produce good applications software as quickly — and therefore as cheaply — as possible by providing a useful set of 'interfaces' between the program and the hardware. And — maybe more importantly — they should enable the fast-growing pool of naive users to use their micros as efficiently as possible, with minimal training and/or specialised knowledge.

There are two other, less immediately obvious, qualities that our

WHAT IS CP/M

In a microcomputer, the operating system is the link between the computer's hardware and the program actually in use. An operating system such as CP/M consists in essence of a series of routines which perform all the boring mundane but essential tasks involved in computing. This includes things like accepting a character typed at the keyboard, displaying it on the screen, sending characters to the printer and handling the detailed work involved in dealing with disk files. Figure 1 shows how this works on a micro: at the centre is the hardware; between this and whatever programs are being used is the operating system, the program called CP/M (which stands, in case you wondered, for Control Program/Microprocessor). The operating system thus acts as a 'buffer' between the hardware and other software, which could be either applications programs written in assembler language, as



*Approx address - depends on size of BIOS
**Area below 100H not shown to scale!

Fig 2. Memory maps for CP/M systems: a) A 64k system

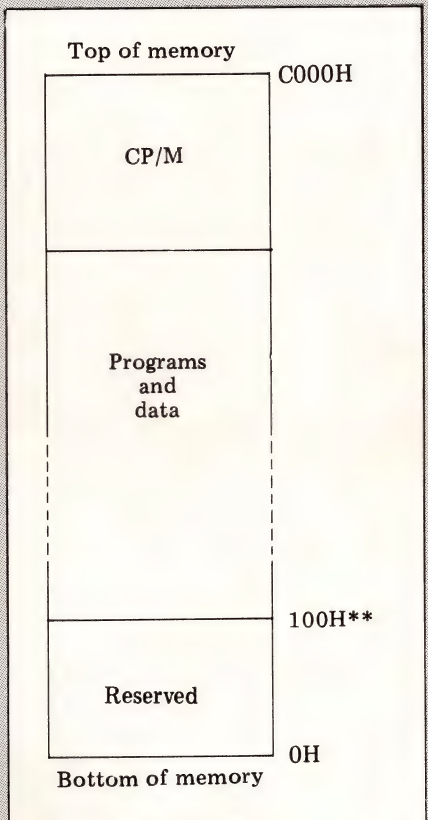
shown in the left half of the circle, or a language interpreter which is interpreting an applications program written in a high-level language such as Basic.

Programming under CP/M

As most programs need at least the ability to accept keyboard input and to display something on the screen, it makes life a lot easier for the programmer if the routines to do this are already available and don't have to be re-written every time a new program is being developed. In addition, the way the computer's hardware is arranged differs from machine to machine, so that while one computer may have Port 0 as its keyboard port, another might use Port 50 for this purpose. A special section of CP/M, called the BIOS (Basic Input/Output Section) contains all the routines which are 'machine-specific' (i.e. which involve special hardware features which differ between micros) so that, to install CP/M on his product, a manufacturer has only to re-write portions of the BIOS as appropriate.

With the BIOS suitably customised and CP/M successfully installed, any program written for CP/M will then be able to run on it without modification because to perform any of the basic system functions (getting or displaying a character, for instance), the program has merely to execute a subroutine call to an address in a reserved part of memory which is *always* the same, no matter which machine is being used.

As an example of how this works, let's suppose we want to send the character 'A' to the screen. Figure 2a shows the memory map of a typical CP/M computer, from which you will see that the first 256 bytes of RAM, from locations OH to OFFH are reserved for CP/M and that CP/M itself occupies the topmost portion of RAM, typically about 8k or so. In between, starting at location 100H, is the area where programs and data are kept; all CP/M programs must therefore be written to start at 100H.



b) A 48k system

Exactly what CP/M does with all of those 256 bytes needn't concern us here; we're interested in just one location, at 5H. To put the character 'A' on the screen, we must first load it into the processor's E register (remember we're dealing only with the 8080 and Z80 chips), and the *system call* number in the C register. The system call number is simply the number of the operating system routine we wish to execute, obtained from the CP/M documentation which lists all the calls – in this case we want system call 2, so we place the value 2 in C. We now execute a subroutine CALL to location 5. Locations 5, 6 and 7 contain a JUMP instruction to the address inside CP/M up at the top of memory where the routine to work out which function we want and then to execute it lies. The function is executed and CP/M then carries out a RETurn from subroutine instruction to return us to our program.

This may at first sight look a little tedious but in fact it's done for a very good reason. With CP/M you get a utility program to generate a version for any memory size (above 16k); if you want to generate a version of CP/M for a 48k system instead of the standard 64k, you run this program, feed in the relevant details and it produces a new version, which would look something like the memory map in Figure 2b. Notice, though, that this new version still requires those 256 bytes at the bottom; if you were to compare the contents of locations 5, 6 and 7 in the two versions, you'd find they JUMPed to different addresses – the configuration program had so arranged things that, while the addresses of the actual systems calls themselves had changed, a program using them would still work – all that would happen is that when the CALL to location 5 was made, a different address would be JUMPed to automatically, without any modifications being required to the actual program.

CP/M thus frees the programmer of two major headaches: hardware features and memory size. Provided a system has enough memory to contain the program plus whatever extra space the program needs for data storage, it will run on any CP/M machine regardless of the machine's hardware configuration and memory size.

The example I have given is based on the way CP/M-80 works; CP/M-86 and MS-DOS are slightly more complicated but are based on the same principles.

In use

When the user switches on his machine and inserts the system disk, CP/M is loaded into memory and control is passed to a section of it which displays the 'A>' prompt and waits for something to be typed in at the keyboard.

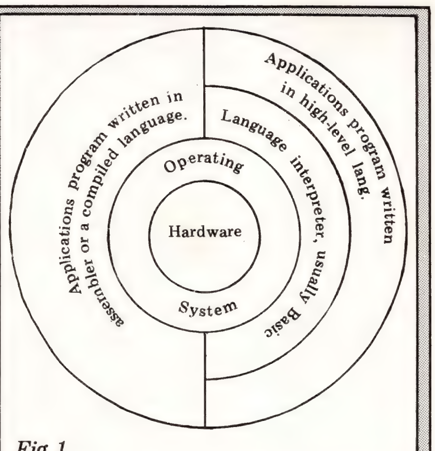

Applications program written in assembler or a compiled language.
Applications program written in high-level lang.
Language interpreter, usually Basic
Operating System
Hardware

Fig 1

As each letter is typed in, CP/M places it in a reserved area of memory (within that 256-byte lower section) and waits for the next character. It keeps doing this until a carriage return is typed to signify the end of the command. CP/M then checks first to see whether what has been typed is the name of one of its built-in or *intrinsic* commands, such as DIR, the command to display a disk directory; if it is an intrinsic command, CP/M executes it and goes back to displaying the 'A>' prompt and waiting for the next command.

If the command isn't an intrinsic command, CP/M then searches the disk directory for a program with the same name. If found, the program is loaded into memory from location 100H onwards and control is passed to that program. If there isn't a program with that name on disk, CP/M indicates this fact by the rather crude expedient of re-displaying what you typed followed by a "?" and going back to waiting for another command.

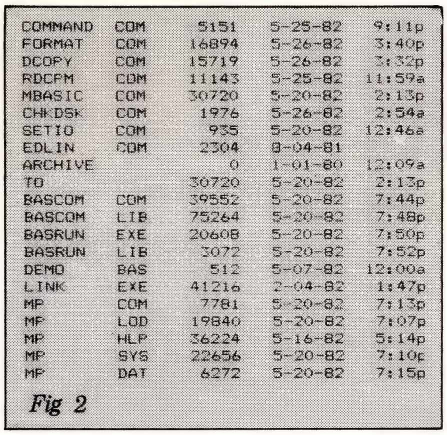
CP/M-80, CP/M-86 and MS-DOS are all single user, single task operating systems. This means that only one person at a time can use the machine to perform only one task at a time. There are operating systems for micros which will allow single user multi-tasking operating, in which one user can have several jobs running at the same time; such a version of CP/M-86, called Concurrent CP/M-86, is promised for the future and it seems logical to assume that a similar version of MS-DOS could be on its way.

Attempts have been made to produce multi-user operating systems for micros. Trying to do this with an 8-bit system has proved fairly unsuccessful as the poor little processor gets swamped pretty quickly. Even on a 16- or 32-bit micro, the exercise is, frankly, pointless; each user must be provided with a screen and keyboard, both of which are relatively expensive. The processor is made to serve several users by means of a complex (and therefore expensive) operating system yet the processor is the cheapest part of all! It makes far better economic sense to give each user a processor of his/her own – i.e. to give them each a microcomputer – and network the micros together to share just the expensive parts such as hard disk drives and daisywheel printers.

MS-DOS v CP/M-86

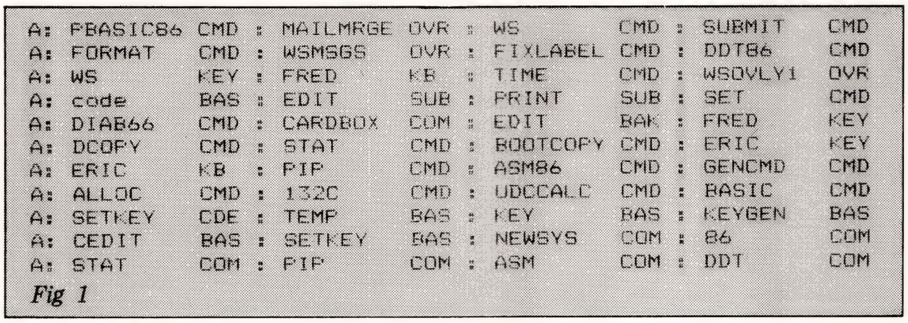
'perfect' operating system should have: robustness and consistency. Robustness means that if the user does something wrong — say he tries to write to a write-protected disk — the operating system should recognise the error, give the user a useful error message ('That disk is write-protected, nerd!') and allow him to correct the error quickly and easily. He should be able to recover from the error situation and continue with his applications program unhindered. Consistency means that the command syntax should always follow the same style, so that if he needs to use one of the system's more obscure commands — maybe one he's never used before, or has used very infrequently — he should be able to guess the correct syntax simply by using the same format as is required by all the other commands; there should be no unpleasant, difficult-to-remember exceptions to the command syntax and, as far as our upcoming band of naive users is concerned, the command language should be in something closely resembling English as she is spoke, rather than in terse, arcane abbreviations.

Such a 'perfect' system would have to be a fairly large piece of software and there was never really any question of developing such a thing for 8-bit micros because they are limited to 64k of memory; there's not enough space to hold a big operating system and leave a sensible amount of room for a business package and its data. But 16-bit micros, with their much larger addressing capacity, do give us the room we need, especially as the price of memory is falling continually. Their increased processing power means that, although there would be a far greater amount of thrashing about to be done, the net result should still provide the end user with faster response times and a quicker-running programs than he currently gets with an 8-bit machine.



```
COMMAND  COM     5151  5-25-82   9:11p
FORMAT   COM    16894  5-26-82   3:40p
DCOPY    COM    15719  5-26-82   3:32p
RDCPM    COM    11143  5-25-82  11:59a
MBASIC   COM    30720  5-20-82   2:13p
CHKDSK   COM     1976  5-26-82   2:54a
SETIO    COM      935  5-20-82  12:46a
EDLIN    COM     2304  8-04-81
ARCHIVE             0  1-01-80  12:09a
TO              30720  5-20-82   2:13p
BASCOM   COM    39552  5-20-82   7:44p
BASCOM   LIB    75264  5-20-82   7:48p
BASRUN   EXE    20608  5-20-82   7:50p
BASRUN   LIB     3072  5-20-82   7:52p
DEMO     BAS      512  5-07-82  12:00a
LINK     EXE    41216  2-04-82   1:47p
MP       COM     7781  5-20-82   7:13p
MP       LOD    19840  5-20-82   7:07p
MP       HLP    36224  5-16-82   5:14p
MP       SYS    22656  5-20-82   7:10p
MP       DAT     6272  5-20-82   7:15p
```

Fig 2



```
A: PBASIC86 CMD : MAILMRGE OVR : WS       CMD : SUBMIT   CMD
A: FORMAT   CMD : WSMSGS   OVR : FIXLABEL CMD : DDT86    CMD
A: WS       KEY : FRED     KB  : TIME     CMD : WSOVLY1  OVR
A: code     BAS : EDIT     SUB : PRINT    SUB : SET      CMD
A: DIAB66   CMD : CARDBOX  COM : EDIT     BAK : FRED     KEY
A: DCOPY    CMD : STAT     CMD : BOOTCOPY CMD : ERIC     KEY
A: ERIC     KB  : PIP      CMD : ASM86    CMD : GENCMD   CMD
A: ALLOC    CMD : 132C     CMD : UDCCALC  CMD : BASIC    CMD
A: SETKEY   CDE : TEMP     BAS : KEY      BAS : KEYGEN   BAS
A: CEDIT    BAS : SETKEY   BAS : NEWSYS   COM : 86       COM
A: STAT     COM : PIP      COM : ASM      COM : DDT      COM
```

Fig 1

dir	Display directory of disk in default drive
dir d:	Display directory of disk in named drive
dir filename.ext	Search for named file on disk in default drive
dir d: filename.ext	Search for named file on disk in named drive
dir *.ext	Search for files with named extension on default drive
dir filename.*	Search for all named files with any extension on default drive
dir x???????.*	Search for all filenames beginning with x with any extension on default drive
era filename.ext	Erase named file on default drive
era d: filename. ext	Erase named file on named drive
era *.*	Erase all files on default drive
era *.ext	Erase all files with named extension on default drive
era filename.*	Erase all named files with any extension on default drive
ren newname.ext=oldname.ext	Rename file on default drive
ren d: newname.ext=oldname.ext	Rename file on named drive
type filename.ext	Display the named file on default drive
type d:filename.ext	Display named file on named drive

Fig 3 CP/M-86 intrinsic commands

bootcopy	Copies the operating system from the system sectors of one disk to those of another
dcopy	Copies entire contents of disk in one drive to disk in another, simultaneously formatting the second disk if necessary
format	Formats disk
pip	Similar to CP/M-80's PIP but more powerful than MS-DOS's intrinsic copy command as it can copy files to the console or other peripheral device as well as having concatenation capabilities
stat	Also similar to corresponding CP/M-80 command — displays information about files on a disk and space remaining but also allows different devices to be configured to the computer, eg, a serial printer instead of a parallel one
submit	Batch processor which takes a list of commands in a pre-prepared file and executes them sequentially

Fig 4 CP/M-86 utilities

I have gone on at some length about the requirements of the naive computer user because, after all, it is he for whom the microcomputer is designed (a fact which seems to escape some hardware and software producers, even now). As I said earlier, nearly all business micros are — and will be in even greater numbers — sold to such users and it's up to the industry as a whole to give them what they need and want, not what some cloistered academic feels they ought to get or what some manufacturer decides is the cheapest and easiest thing to give them.

In the following comparison between MS-DOS and CP/M-86 , then, I have very firmly taken the user's side. Although a good operating system should make life easier for the programmer too, to lower software development costs and development times, in the end it's the attractiveness or otherwise of the system to the user that's the most important consideration.

On the surface

Both operating systems make no secret of their lineage: they both betray strong influences of CP/M-80 to the extent that it's frequently impossible to tell that you're using a 16-bit system. Many of the commands used by both systems are identical to those of CP/M-80, which is a mixed blessing indeed: anyone moving from CP/M-80 to either 16-bit system would find the transition easy but all the boring, awkward things are there too.

When first booted up, CP/M-86 behaves exactly like CP/M-80 and gives you the famous 'A>' prompt. MS-DOS asks for the date and time, for reasons I'll come to in a moment, and then gives the same prompt. This 'A>' prompt can be very confusing, escpecially in the environment in which I have been running both systems, a Sirius 1 equipped with a Z80 card to allow it to run CP/M-80 as well — three operating systems on one machine, all with the same prompt!

Typing DIR for a directory gives the first major difference. CP/M-86 displays exactly the same directory listing as CP/M-80, a list of file names across the screen and that's all — see Figure 1. MS-DOS is much more helpful, presenting a list of names, the exact size in bytes and the date and time each file was created or last altered, plus the total number of files on the disk — see Figure 2. This finer 'granularity' of MS-DOS is said to indicate that it uses the disk space more efficiently than CP/M-86, in which the minimum recognised file length is a rather hefty 2 kbytes. All this information is extremely useful and I can see no excuse for

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JLH/MC1

Copy fs	Copy file onto default drive
copy fs1 fs2	Copy first file onto second file
copy fs1+fs2 fs3	Copy first and second files onto third file
copy/b fs1+fs2	Copy first and second binary files onto first file
copy fs1/b+fs2/a fs3/b	Copy first binary and second ASCII files onto third binary
copy fs1/a fs2	Copy first file up to first embedded CTRL-Z onto second file
copy *.ext fs	Copy first file group onto second file
copy *.ext1 *.ext2	Copy files with extensions matching first onto second file group
date	Display date
date mm-dd-yy	Set new date
del fs	Delete named file
del *.ext	Delete all files with matching extensions
del d:filename.*	Delete all files on named drive with matching name regardless of extension
dir	Display directory of disk in default drive
dir d:	Display directory of disk in named drive
dir fs	Display directory entry for named file
dir x???????.*	Display directory entries for all files starting with x regardless of extension
pause	Suspend execution of batch file
pause (comment)	Suspend batch file execution and display comment
rem (comment)	Display comment during batch file execution
ren oldname.ext newname.ext	Rename file on default drive
ren d:oldname.ext newname.ext	Rename file on named drive
ren d:*.ext1 *.ext 2	Change extensions of all the files with ext1 on named drive to ext2
time	Display time
time hh:mm	Set time — hour and minute
time hh:mm:ss	Set time — hour, minute and second
type fs	Display named file

Note: fs = file specifier, made up of optional drive name, a file name of up to eight characters and an optional extension

Fig 5 MS-DOS intrinsic commands

chkdsk	Gives details of disk and system memory status — how much used, how much remaining
dcopy	Copies entire disk onto another, formatting second disk if necessary
format	Formats a disk, with option soft error reporting and optional automatic creation of system on second disk
rdcpm	Transfer a CP/M file from a CP/M disk onto an MS-DOS disk. Of course this is for data files only — it doesn't automatically translate a CP/M-86 program into an MS-DOS program!

Fig 6 MS-DOS utilities

Digital Research's failure to provide a similar facility in CP/M-86; it would be even nicer if MS-DOS also indicated how much disk space was occupied and how much was left free. Typing 'DIR/P' with MS-DOS gives a paged version of the directory — the listing stops when a screenful has been presented and prompts you to press any key to list the next screenful when you're ready.

Both systems have wildcard capabilities in the DIR command: typing 'DIR *.BAS' will display only those files with the '.BAS' extension in both systems. And both allow the use of '?' to match any character in a filename, so that DIR BANK???.* will display all files beginning with BANK and having three other letters in their names, such as BANKERS, BANKING, etc.

Programs which are executable directly from the operating system (ie, those which have been written in assembler language or compiled) are fired up merely by typing their name. Under CP/M-86 these programs have the extension '.CMD' while MS-DOS sticks to the original CP/M convention of '.COM'.

An interesting and demi-useful feature of MS-DOS is its 'template'. When a command (such as a program name) is typed in at the keyboard and the return key is pressed, the command is copied into an area of memory called the template. A series of editing commands is available, actioned by pressing the escape key followed by a letter, which allows you to insert or delete characters within the template and to copy the template back into the command line. This means that a complicated command such as COPY A:PROGNAME.BAS B: PROGNAME. BAS can be altered to COPY A: PROGNAME.COM B: PROGNAME. COM without the whole line having to be re-typed, although, personally, I found the sequence of commands to do this just a little tedious. The sequence ESC U copies the entire template into the command line, allowing you to repeat a command with just two keystrokes. A rather pointless limitation with the template facility is that the letter following the ESC must be typed in upper case; this is particularly silly as MS-DOS accepts commands in either upper or lower case and is annoying on the Sirius as its keyboard is always in lower case when the system is first fired up.

Both systems allow you to 'edit' the command line itself, although, frankly, neither are particularly easy to use and I generally find myself using only the CTRL-X feature, found on both, which simply deletes the entire line and allows you to try again. Typing a non-existent program name produces a 'Bad command or file name' error message from MS-DOS, while CP/M-86 merely repeats what you typed (translated into upper case if you had typed in lower) followed by a '?' and the prompt.

A major source of irritation (to me, at least) with CP/M-80 is the requirement to type CTRL-C whenever a new disk is inserted. This is done because the operating system maintains a 'map' of the disk in memory and, if a new disk is inserted without CTRL-C being typed to tell it what's happened, the system gets horribly confused when it tries to access the new disk and finds its contents don't match the 'map'. Very regrettably, CP/M-86 also demands new disks to be logged in with CTRL-C. MS-DOS, on the other hand, is rather more clever: it detects the opening of a disk drive door and automatically logs on the new disk, so there's no need for the user to bother about telling the system what he's done.

It's of paramount importance to make back-up copies of everything you keep on a disk and an operating system should provide a quick and easy way to do this. These two go about it in different ways. CP/M-86 adheres to CP/M-80 practice by providing a utility program called PIP (Peripheral Interchange Program). Calling this program with a command such as PIP A:filename=B:filename will copy a file from the disk in drive B to the one in drive B. Wildcard characters can be introduced, as described in the DIR command above, so that PIP B:=A:*.BAS will copy all files with the '.BAS' extension from drive A to drive B. Files can also be renamed as they are transferred: PIP B:newname=A:oldname.

PIP is in fact much more than just a file-copying utility, for files can be transferred to other devices, such as the screen or printer, by inserting the appropriate device names instead of destination files, such as PIP LST:=B:filename, which would send the file to the printer. Additionally, there's a whole host of parameters which can be tagged onto the end of the command line to do things such as verifying after transfer (for disk transfers only), converting ASCII files from lower to upper case, stripping out form feeds and inserting them after a specified number of lines have been sent.

MS-DOS has no direct equivalent of PIP and approaches the back-up facility in a different way. A command called COPY is built into MS-DOS (rather than being a separate program, as is PIP) but is far less versatile than PIP, although its syntax is rather friendlier. COPY A:filename B:filename transfers the file from the A drive to the B drive — note that the syntax is exactly the opposite to that of PIP! Files can be renamed and concatenated and Cromemco's similar XFER function, for a renamed and concatenated as they are transferred. Having used PIP on CP/M-80 machines, and Cromemco's similar XFER function, for a long time, I found COPY a little awkward to get used to, mainly because of the source-destination reversal in its syntax; other users with no previous CP/M convictions have found it far

MS-DOS v CP/M-86

easier to use than PIP and certainly the word 'copy' makes a lot more sense to the naive user than 'PIP'.

Syntax reversal also takes place with the command to rename (without transferring) files: REN B:oldname newname for MS-DOS, REN B:newname=oldname for CP/M-86 to change the name of a file on drive B. File deletion is carried out with DEL filename for MS-DOS and ERA filename with CP/M-86; both renaming and deletion can be used with wildcards on both systems. Wildcards can be rather dangerous when deleting files so both operating systems trap any attempt to delete everything on a file using DEL *.* or ERA *.*. CP/M-86 rather tersely asks 'ALL (Y/N?)' while MS-DOS produces a genteel 'Are you sure (Y/N)?' In both cases, typing 'n' aborts the command, leaving your files intact.

While on the subject of messages, I should mention what happens when you try to write to a write-protected disk. True to its ancestry, CP/M-86 gives an expanded — but just as useless — version of the now-infamous 'BDOS err on B: Bad sector' message. MS-DOS is slightly better, with 'Disk error writing drive B Abort, retry ignore'. Neither matches my Cromemco's 'Diskette in drive B is write-protected' message under the same circumstances.

Both operating systems have a TYPE filename command which simple throws the contents of an ASCII file onto the screen and, optionally, to the printer too.

MS-DOS has two additional built-in commands for which there are no CP/M-86 equivalents, TIME and DATE. These display the time and date respectively and offer you the chance to update them if required. You can set both as part of the command line by typing, for example, DATE MM-DD-YY; note the American date format which, irritatingly, is compulsory.

Other utilities

Both operating systems come with very comprehensive utilities to configure the operating system to your particular needs, such as catering for parallel or serial printers and — for the Sirius — defining character sets and keyboard layouts. Additionally, both systems have a number of other utility programs for performing various 'housekeeping' functions.

Both have a FORMAT program to format new disks and in both cases this can optionally display a report of any faults encountered during the formatting process. The MS-DOS FORMAT program will also, if the option is selected, place a copy of the operating system on the newly-formatted disk. CP/M-86 has a separate program called BOOTCOPY to do this.

Both also have a program called DCOPY which will copy the entire contents of a disk from one drive to another, including the systems tracks, and both will format the destination disk automatically if necessary. This provides a very hand and quick method of taking a backup copy and in both cases you have the choice of typing DCOPY A: to B: to do it automatically or just DCOPY, which will load the program and prompt you for source and destination drives, giving you the chance to insert a fresh source disk to be copied if required.

The powerful STAT program has been transferred from CP/M-80 to CP/M-86. This allows you to check the amount of space left on a disk, to list the files on a disk alphabetically with a report on their lengths and to change certain features of the operating system; the latter facility allows you to, for example, change the default system printer from a parallel to a serial unit with STAT LST:=LPT:. STAT is a little like PIP in terms of its power and extent and once again there isn't a direct equivalent in MS-DOS. There is a CHKDSK command to give a summary of a disk's space alloction and, of course, file sizes are shown in the DIRectory listing.

Both systems allow you to set up batches of jobs to be done. A text file is written with a word processor or line editor, containing a list of programs to be executed in the order in which they are to be run. To be recognised as a batch file, this must have the extension '.BAT' for MS-DOS and '.SUB' for CP/M-86.

CP/M-86 requires a special program called SUBMIT to run a batch file; you simply type 'SUBMIT filename' and the commands are executed in sequence. However, the disk containing SUBMIT must not be write-protected as SUBMIT creates a temporary file on disk while it's working. Batch processing is much simpler under MS-DOS: the batch processing software is built into the operating system and one merely types the name of the batch file for it to be executed. If the disk contains a file called AUTOEXEC.BAT, this will be executed automatically on boot-up, over-riding the automatic requests for time and date.

Performance

As both operating systems are single-user, single-tasking systems, there isn't a great deal to say about their performance, except in the area of disk handling. Here, MS-DOS seems to be noticeably quicker than CP/M-86 although lack of time has prevented my running a series of benchmark programs to show just how much faster it is. I did, however, time the loading of Microsoft's Basic 5 interpreter under both systems, in each case from a disk which was otherwise empty. Under CP/M-86 this took an average 4.8 seconds while MS-DOS took 2.1 seconds. Using a variety of other packages, such as Wordstar under CP/M-86 and Multiplan under MS-DOS, I certainly seemed to spend less time waiting around for disk access with MS-DOS than with '86, although until Wordstar becomes available under MS-DOS, I won't be able to quantify this different, either.

Documentation

As I was using both systems on a Sirius, I had the Sirius manuals to both systems. These were user's guides and explained all the facilities of each system thoroughly, with examples, and with excellent use of typography to clarify things.

I have seen very early versions of the CP/M-86 programming guide and these seemed slightly better than Digital Research's previous attempts at documentation. Despite a couple of letters and phone calls to Microsoft, I have not yet managed to get my hands on any 'official' MS-DOS documentation and therefore cannot comment on it.

Programmers will certainly need further information on both systems before they can get to grips with them. I understand the documentation is now ready in its final form for CP/M-86 and full programming aids including an assembler and debugger — in fact precisely the same tools as are provided with CP/M—80 — are now available for CP/M-86. Curiously, Microsoft seems to have taken its time to produce an MS-DOS assembler but I'm told this has now been done and will be available very shortly. Several companies are already offering high-level language compilers for both systems — Microsoft has produced a Basic compiler for MS-DOS and there are Pascal, Cobol and C compilers out now for both systems.

Conclusions

My main aim in investigating these two operating systems has been to see how closely or otherwise they approach the 'perfect' operating system outlined earlier. I must state now that neither come anywhere near this standard but that's not too surprising, given their ancestry and the current newness of 16-bit microcomputers. It will take a while for somebody to develop the 'perfect' system and even longer for it to become recognised as such and adopted as a standard, by which time of course we'll be ankle-deep in 32-bit machines and gigabytes of RAM!

For users graduating from CP/M-80 micros, CP/M-86 will of course be the more familiar of the two. This means that the simplicity of CP/M-80 has been retained but so also have its bad points, especially its very unhelpful user interface. A 'Help' facility is supposed to be on its way to supplement CP/M-86 in some way, but I'm not sure at the moment whether this will be integrated into a new version of the system or supplied as a separated, but linked, text file; I suspect the latter.

MS-DOS is certainly friendlier than CP/M-86 and definitely gives faster disk handling. It incorporates sensible error messages (well, much more sensible than CP/M-86) and generally feels a lot more robust and easier to use.

Of the two, then, I found MS-DOS the nicer to use. At present there seems to be less in the way of applications software available to run under it than is currently up and running under CP/M-86 – but I expect this situation to change pretty quickly as more and more software for the IBM Personal Computer becomes available on this side of the Pacific and, of course, as more machines running MS-DOS appear.

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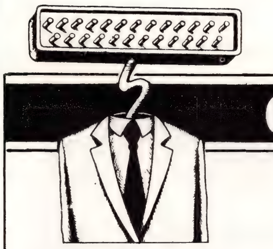

COMMUNICATIONS

APC welcomes correspondence from its readers but we must warn that it tends to be one way! Address letters to: 'Communications', APC, P.O. Box 280 Hawthorn, Vic. 3122.

One-liner

Here is another of those one-liners for a Tandy or System 80: this one is for Bio-rhythm and sine wave freaks!

```
0  X=X+ .25: FOR Y=1 TO
6: POKE SIN(X/Y)*32+
16288, Y+48: NEXT: PRINT:
GOTO
```

Points to mention are that GOTO without a line number goes to line zero, and that memory location 16288 is the middle of the bottom line of the screen.

B Newsam

((Down (with (brackets))))

Many thanks for printing Michael Liardet's excellent article on Lisp. This looks like a really powerful language, quite easy to learn and a lot more fun than Pascal. The only unattractive feature for the micro enthusiast is the extent of the use of nested brackets. These are a hassle to use and a bore to check. But have you noticed they are also entirely unnecessary. In fact, the notation used by Lisp (prefixed dyadic operators) was invented just to dispense with the need for nested punctuation.

Mr Liardet's first example of Lisp code can be written out, omitting the brackets, like this:

```
COND
   OR
      EQ
         PLUS A B
         2
      LESSP
         TIMES C D
         5
   SETQ
      E
      MINUS C D
```

Here indentation is used to show the structure of the conditional, e.g. the arguments of 'COND' are 'OR' and 'SETQ'; those of 'OR' are 'EQ' and 'LESSP', etc. This too is dispensable from the compiler/interpreter's standpoint. The whole conditional could be written as a single line of code and, if the reserved words were 'tokenised', this would slightly *decrease* execution time compared with the bracket-ridden version.

The ideal solution is: make brackets optional, on input and on listing. The usual restriction on variable names, that they should contain no spaces, is enough to avoid ambiguity.

John Kerr

This works fine for dyadic operators, but the brackets in Lisp are primarily intended to delimit lists. How do you show a list of lists without them? – Ed.

TRS-80 troubles

Could you please tell me where I could get some advice about my TRS-80 microcomputer?

Martin Pearce

I own a TRS-80 which I have attempted to upgrade myself. Unfortunately I cannot get the upgrade to work so where can I get advice?

J Harrison

I believe very strongly in self-help. This can be achieved by joining a local club, or user group. There you will find others who have surmounted similar problems. This applies to any computer system, not just to the TRS-80. Look through APC's user-group index published in the March 1982 issue and join one straight away. – Ed.

Stop it!

How can I stop the computer responding to control characters when using Basic's INPUT$(1) command?

D Salkeld

Simply test after the input – for example:

```
100 CH$=INPUT$(1):
    CH=ASC(CH$)
110 IF CH<32 OR CH >122'
    THEN 100
120 PRINT CH$;
```

Using this technique you can restrict the input to only the numeric keys, for instance. – Ed.

X-ray vision

I have a question of my own and I hope some readers may be able to answer it.

Colour TV sets give off X-rays. It has been assumed

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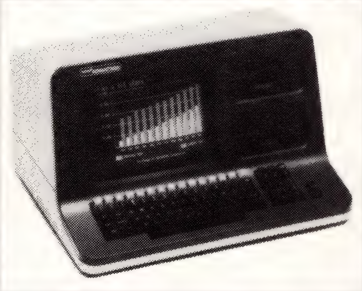

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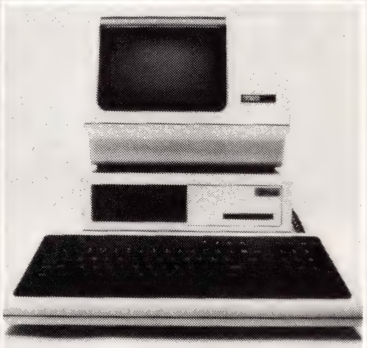

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that this causes no problems when watching at home because of the usual viewing distance from the set. However, it worries me to think that I am being saturated by X-rays when using the colour TV attached to a computer, because I sit less than one metre from the screen. I have no desire to die of these effects on *APC's* behalf, so could someone reassure me and readers that the effect is not worth worrying about?

Sheridan Williams

Wrong Shmunck

A bit of a small goof occurred in the July issue. Those of you who have had the various 'flus going around will understand how I managed to send in my working copy of "SHMUNCK".

The changes needed are minor, and I doubt that given the wide range of numbers you can program in, that anybody found anything wrong (fingers crossed).

The program was intended to use double precision numbers, and Line 10 should be changed to

```
10 CLEAR 400:DEFDBL V,E
```

As this requires extra memory for the arrays, we need to DELETE some of those REM statements.

```
DELETE 70,80,90,350,370,
550,560,570,610,620,630,
780,790,1020,1030,1160,
1170,1180,1350,1370,1920,
1930,1940,2020,2030,2040,
2190,2210
```

If you require more memory cleared for any reason (such as an expanded APC-80), or deleting those REM statements makes you weep, then just

```
DELETE 1570-1620
```

The directions for program use are better in the magazine anyway, and they won't be used once you get used to the requirements (that's what I did in my final version).

Change line 700 to read

```
700 IF V2<0 THEN E4-INT
    (E2-E3):GOTO 720
```

Note that the first E2 is changed to V2. Using E2 was to limit the parameters when equal positive and negative values were entered for division parameters (making it easy for my slow mind to check out the division processing).

In order to enter a play time when selecting the pre-programmed menu;

Change

```
1540 B$=INKEY$:IF B$="Y"
    OR B$="N" THEN 1550
    ELSE 1540
1550 PRINT@772, "PLEASE
    PUSH THE REQUIRED
    PLAY TIME (1 TO 5)
    Q$=INKEY$:IF Q$<"1"
    OR Q$ >"5" THEN 1550
    ELSE Q=VAL(Q$)*1000
1560 IF B$="Y" THEN D=1:
    GOTO 1565 ELSE 2050
```

Insert

```
1565 PRINT@772, "ENTER
    THE NUMBER OF
    DIFFICULTY LEVELS
    YOU WANT(1-12)"
    ;:INPUT X1:IF X1<1 OR
    X1 >12 THEN 1565
```

Lastly, I would be most interested to hear from people who might have ideas on educational themes that they would like to see written, or any way to extend the capabilities of "SHMUNCK". (A subroutine to limit borrowing for addition and subtraction is on it's way, time allowing).

Brian Christmas,
Webster Street, Eaglehawk 3556

Puzzle explained

With reference to the Prize Puzzle in Lazing Around, July *APC*, the factors of 2*10∧6 are composed of 2*(2*5)∧6, i.e.

2∧7*5∧6; 2*2∧6*5∧6;
2∧2*2∧5*5∧6; 2∧3*2∧4*5∧6
2∧7*5*5∧5; 2∧7*5∧2*5∧4;
2∧7*5∧3*5∧3

so that all factors can be accommodated in a 7*8 array produced by the routine

```
FOR I=0 TO 7:FOR J=0 TO
    6:A(I,J)=2∧1*5∧J:NEXT
    J:NEXT I
```

The routine

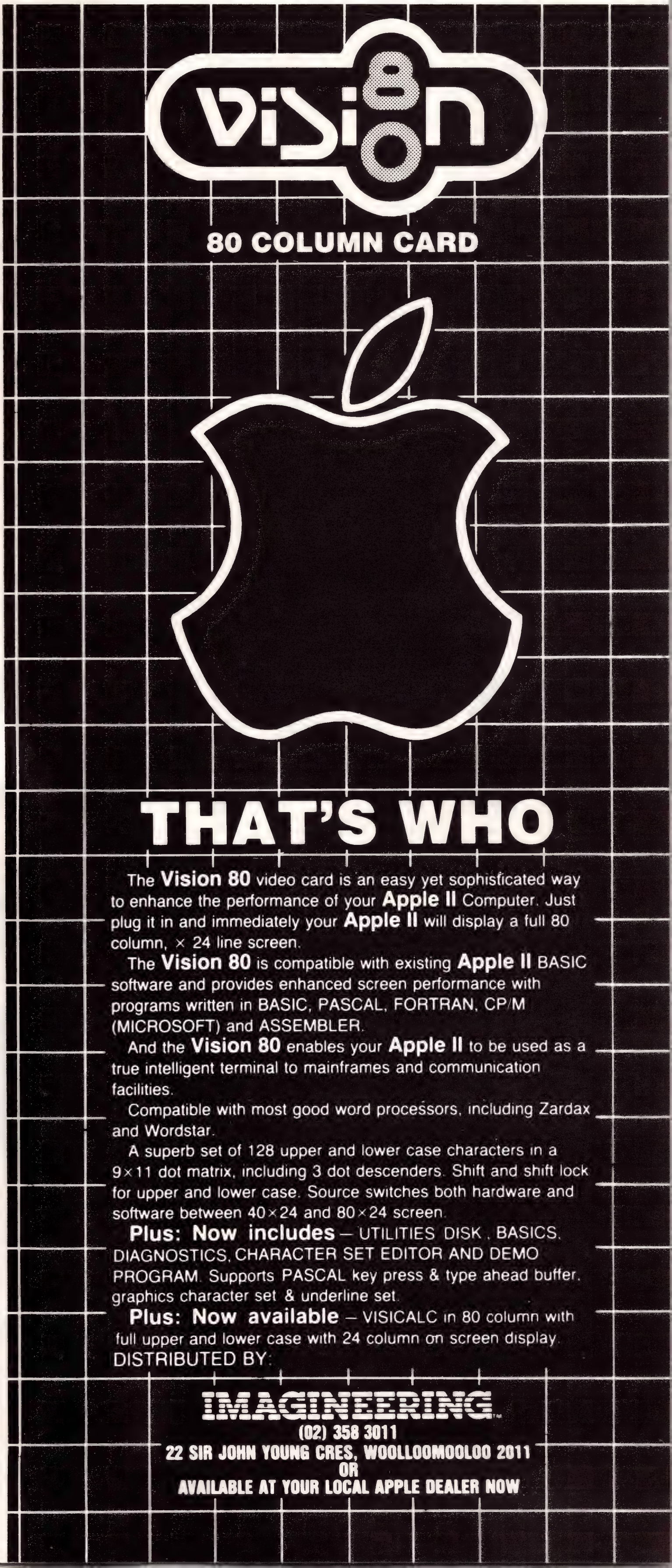
```
B=A(I,J)∧2:B=B+2000000:
    B=B∧(1/3):C=INT(B):IF
    B-C=0 THEN
```

checks the factors against postulates. Since each factor is checked once only, it is not necessary to use an actual array; the two routines can be combined in a single loop

```
10 FOR I=0 TO 7:FOR J=0 TO
    6:A=2∧I*5∧J:B=A∧2:B=B
    +2000000:B=B∧(1/3)
20 C=INT(B):IF B-C=0 THEN
    PRINT"Solution:"A
30 NEXT J:NEXT I
```

This produces no solution. Being suspicious by inclination and experience, I added a display step to get A on the screen – and found that my otherwise excellent MBasic 80 has yet another bug: while it can do 2∧1 and 5∧5 and multiply the two results accurately for 6250, 2∧1*5∧5 produces 6249.0. The same error appears for 2∧2*5∧6, 2∧5*5∧5 and 2∧6*6∧6. Well, I am not a Basic fan at the best of times, although I find it useful for "quickies" like this.

However, back to the story: assuming that a solution might be hidden among the larger factors as a result of limited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precision in my Basic, I modified the above programlet to print out the factors of 2*10∆6 and proceeded to check each by hand. Still no soap, although some came very close (for instance, the largest factor of all, when squared and added to 2,000,000 produces a number equal to the cube of 10,000.007). The only conclusion I can come to is that there is no solution to the problem.

Jan Wikstrom

Osborne rub-out

I have recently started to use an Osborne 1 and am generally impressed by it. The keyboard is not as solid-feeling as I would like, but must obviously be light for portability. However, there is one curious and awkward omission, which is the lack of a DEL (or RUBout) key. This is particularly frustrating when using Wordstar, as deleting the character just typed then needs Control-S to backspace, followed by Control-G to delete the character the cursor is then on, rather than just pressing DEL. Is there any way to provide a DEL function on this machine?

(Name and address withheld by request)

There are in fact at least two ways to overcome this problem. The first is to make use of the ability to program the numeric pad keys to generate the ASCII code for DEL (127 decimal).

Alternatively, and much simpler, pressing Control together with the minus sign key will generate DEL. – Ed.

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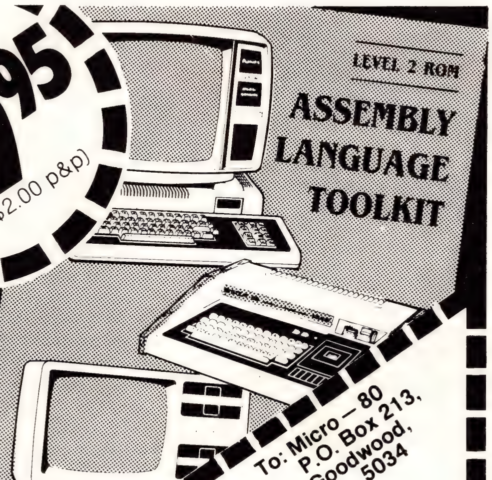


DATA DABBLING

A MULTI-FILE DATABASE SYSTEM

J A B Leeser describes how he wrote his own UCSD Pascal relational database system.

The idea of writing a type of relational database system for a microcomputer was born just prior to my arrival in Brazil. By this time I felt that I had sufficient mastery of Pascal (UCSD), had done some preliminary studies on tree structures and written a general routine for the binary search of an array — the last two without any specific objective in mind.

My interest in relational databases had been stimulated some three years before by V Nederhof, of UIMC BV, Rotterdam, who had lent me C J Date's *An Introduction to Database Systems*. A time of much travelling and too little home life intervened, but the conviction that the relational approach ought to offer the simplest solution to retrieving information from structured data had stayed with me. Once settled in our new home, I resolved to use what little spare time I had to write the index-driven database system for a micro.

Overall structure

The decision to use only standard Pascal data structures was made at an early stage. Next, the central database subsystem had to be built on a data file structure, consisting of records with a number of header fields followed by ten general-purpose string fields meant to contain the main data. Clearly, this general structure had to be given a specific form to reflect a particular data file. Thus it had to be associated with a format derived from a format, or Data Dictionary sub-system. On the other hand, data files were to be manipulated by means of indexes. Thus an index subsystem was required, leading into some form of output system to provide results. Connecting these sub-systems by a menu, the overall structure of DABS, as it came to be called, is shown in Fig 1.

This structure turned out to be adequate in the end and is described in more detail below.

Data dictionary subsystem

The Data Dictionary subsystem consists of three main functions, effectively three programs, which may be represented as in Fig 2.

The first task is to create a format file (when necessary) to insert records carrying file and field names and to delete unwanted records. The second is to create an inverted file listing field names of all records in alphabetic order, giving the appropriate file name. Both these functions use binary tree structures (B trees) for sorting in main memory. The third function lists either file on the printer.

The file name of the appropriate format record is a prerequisite for operating with a particular data file. The field names held in the format file define the data file fields. Thus no data file operation can take place unless a format record for that data file exists. The alphabetic list of field names is included as a very simple reference to

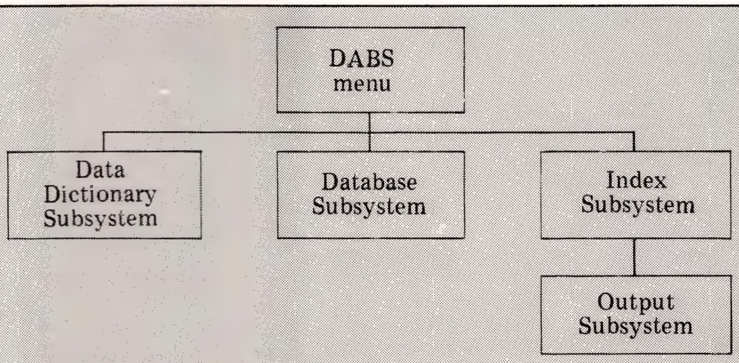


Fig 1

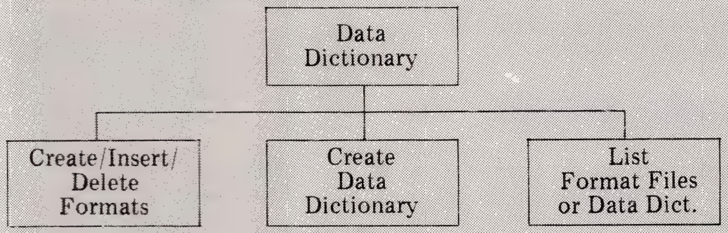

Data Dictionary
Create/Insert/ Delete Formats
Create Data Dictionary
List Format Files or Data Dict.

Fig 2

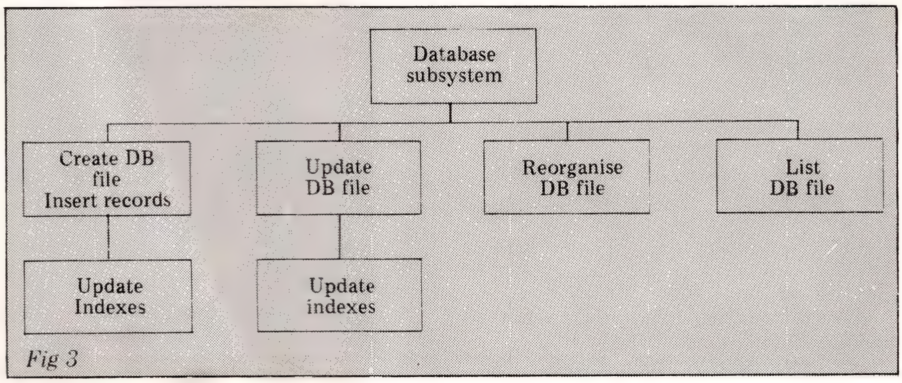


Fig 3

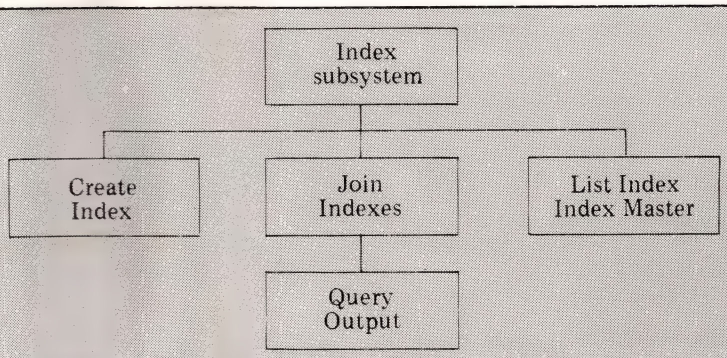


Fig 4

field names and where they are used, but is of no further importance in the system as a whole.

Database subsystem

The Database subsystem's functions are: to create files and insert records, to update fields of all or specific records (including deletion of records), to reorganise files and to list them, as depicted in Fig 3.

It will be noted that both the Create/Insert function and the Update function automatically update all indexes related to the data file, at least in all those cases where they exist, having been created in the first place by the Index sub-system (an index is a file holding records or elements of key fields and the relevant data file record numbers, ordered in key field sequence and, optionally, obeying specifiable selection criteria). Thus an index will always reflect the correct state of the data file within the rules relevant to the original definition of that index (its 'scope').

The Update function is itself controlled by an index. It permits changing one or more fields, including the status field, over the scope of the index and offers the choice of a 'global' or a record-by-record update. The status field has either the value L(ive) or the value D(ead). Dead records are intended to be deleted by the Reorganisation function and, pending this final decision, are ignored by the system.

The index system

Just as the format file record is essential to the creation, etc, of a data file, so is the index (or indexes) for the retrieval of information from that data file. The index, specifies which records of the data file are to be used for retrieval of results. As we have seen, indexes are automatically updated by two of the database functions. However, they have to be specified and created in the first place. This is one of the tasks of the Index subsystem, the other being to join two indexes over a given field. The result of this sort of 'join' is, normally, a table formed by concatenating elements from two indexes, such that the elements of each index have the same key-field value. The general scheme of the sub-system is shown in Fig 4.

Index creation offers a number of special facilities:

1. An index may be created, and ordered in ascending sequence, on any data field in the data file record, or on the record number.
2. Selected indexes may be created depending on whether a chosen field is equal to, not equal to, greater than or smaller than a given value or is a member of a user-specified range of values.
3. Use of the 'unique' feature excludes all data file items with the same key field, except the first.
4. A secondary sort of field may be specified for use in cases where a two-key index has to be 'joined' with two other indexes, one having one of the two key fields and one the other.
5. An index will automatically be added to the number of existing indexes, unless specified to replace an existing index.

Details of decisions made in respect of items 1 - 5 are registered in an Index Master File whose primary use is to provide information for automatic updates of indexes, as described above.

The Join function specific to DABS relates two indexes, ordered in the same sequence, such that, if the key field of an element of the 'argument' index is equal to *any* key field of an element belonging to the second or 'target' index, the record number of the data file record forming part of the element of the target index is stored in a result table under the data file number to which the target index belongs. Inequality resulting from a particular set of comparisons, that is, absence of a matching element, leaves a zero in the table. A number of such binary 'joins' can be carried out, the current limit being three. The completed table is stored in a temporary file from which

File 1 : SUP (PLIER)/MAT(ERIAL)

Record no :	1	2	3	4	5	7	7
Scode :	20	10	10	5	15	6	6
Mcode :	100	110	100	120	100	130	140
Mprice :	1.9	2.7	2.0	1.9	2.4	2.1	2.2
Mquality: :	4	5	5	4	4	5	3

File 2 : SUP(PLIER)

Record No :	1	2	3	4
Scode :	5	10	15	20
Sname :	Ferreira	Smith	Perez	Armando
Scity :	Sao Paulo	Londres	Lisboa	Sao Paulo
Scountry :	Brazil	Inglaterra	Portugal	Brazil

File 3 : MAT(ERIAL)

Record no :	1	2	3	4
Mcode :	100	120	110	130
Mname :	Armchairs	Chairs	Cupboards	Tables
Mstock :	60	36	24	48
Depot :	Hayden	Hayden	Hayden	Hayden

Fig 5

Example 1

Task: Print — Sname, Scity, Scountry from the Sup(plier) file for all records of that file having:
Scountry < Portugal (lexically) and Scity in the alphabetic range A to M (both inclusive)

Indexes

The following two indexes are established:

	INDEX 8 (Supplier)	INDEX 9 (Supplier)
Instructions	Sortfield : Scode Selec field : Scountry Selec criter : < Portugal	Sortfield : Scode Selec field : Scity Selec criter : Range A→M
Result	DATA Scode / File no / Record no 5 / 2 / 1 10 / 2 / 2 20 / 2 / 4	DATA Scode / File no / Record no 10 / 2 / 2 15 / 2 / 3

Join table

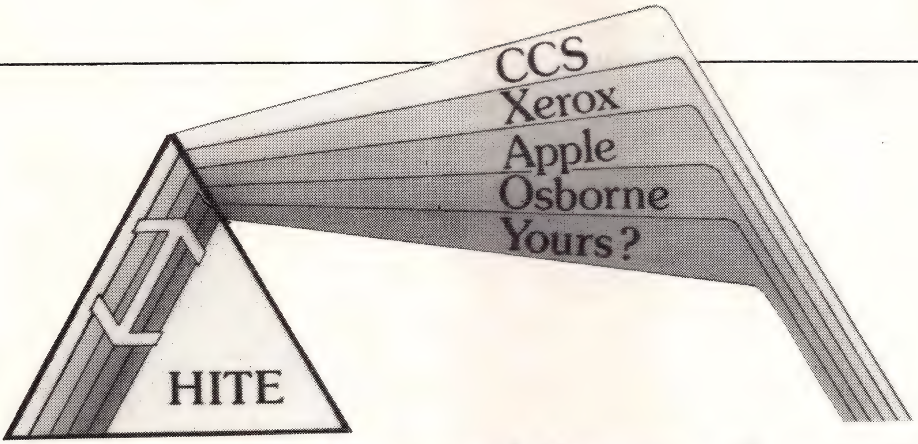
When index 8 is joined to index 9 on the sortfield, the following table results:

0.	File no.	2	0	0
1.	Record row	0	0	0
2.	Record row	2	0	0
3.	Record row	0	0	0
n.	Record row	0	0	0

Output

The output program will recognise only the first column and, within that, the row numbered 2. It will seek record 2 of file 2, having first requested identification of fields to be printed. It will then write these details from the record (either on the screen or the printer):

Sname : Smith
Scity : Londres
Scountry : Inglaterra



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DATA DABBLING

it is picked up by the Output function.

The Output function then examines the table horizontally over the columns in which entries were made by the Join operation, starting from the beginning of the table. For any row of data file record numbers, which does not have a zero in it, the corresponding data file and data file records are accessed and the fields previously stipulated by the user are then written to the screen or to the printer, as required.

Two examples are given of the use of the Index-create, Join and Output functions, based on the data files in Fig 5.

It will be noted that all three files are normalised and that the only connection between them is provided by the Scode and Mcode fields of File 1. Normalisation, while obviously desirable, is however, not a prerequisite of the system as such.

It will be noted that records 6 and 7 of the Supplier/Material data file are excluded. This is because the appropriate records in the other two data files are missing. Note, too, that in order to move index 13 into the table, a unique form of index 13, namely index 15, had to be joined to index 13. Joining index 13 to itself, although perfectly possible, would result in undesirable, additional combinations.

This example indicates the maximum use of the present system — matching three files to provide an answer drawn from all three.

Footnote

Clearly, a multi-file system for a micro has its limitations, primarily of space. DABS, at present, handles 768 records of ten data fields each — not a great deal, but file number, record number and record status are taken care of separately. Given a third disk-drive, somewhere between 900 and 950 records could be handled, after which main memory becomes the restricting factor. A virtue of the system is, however, that it is fast. Sorting, searching and insertion of records (the latter, in some cases only) take place in main memory and access to the main data files is direct, B trees and binary array search methods being used wherever practical.

Two noteworthy points —UCSD Pascal proved entirely adequate for the task, producing code with very few errors. Pascal friends will recognise at once that this is a compliment to the language, rather than to the programmer. Secondly, while an attempt has been made to make DABS as user-friendly as practical, space considerations have made this difficult in at least one case. What can be done to overcome this, remains an interesting exercise for future leisure moments.

END

Example 2

Task: Print — Sname from the Sup(plier) file
Mname from the Mat(erial) file
Mquality from the Sup(plier)/Mat(erial) file

for all records of the Sup(plier)/Mat(erial) file having Mprice > 1.9

Indexes

The following indexes are established:

	INDEX 12 (Supplier)	INDEX 13 (Supplier Material)
Instructions	Sortfield: Scode	Sortfield: Scode 2nd Sortfield. Mcode Selection field: Mprice Selec Criterion: >1.9

Result

INDEX 12 — DATA

Scode	File no	Record no
5	2	1
10	2	2
15	2	3
20	2	4

INDEX 13 — DATA

Scode	Mcode	File no	Record no
5	140	1	7
6	130	1	6
10	100	1	3
10	110	1	2
15	100	1	5

	INDEX 14 (Material)	INDEX 15 (Supplier/Material)
Instructions	Sortfield: Mcode	Sortfield: Scode Selec field: Mprice Selec Criterion: >1.9 Unique: Yes

Result

INDEX 14 — DATA

Mcode	File no	Record no
100	3	1
110	3	3
120	3	2
130	3	4

INDEX 15 — DATA

Scode	File no	Record no
5	1	7
6	1	6
10	1	2
15	1	5

Join table

Index 13 is joined on Index 12 on Scode
Index 13 is joined on Index 14 on Mcode
Index 15 is joined on Index 13 on Scode
} all in Scode sequence

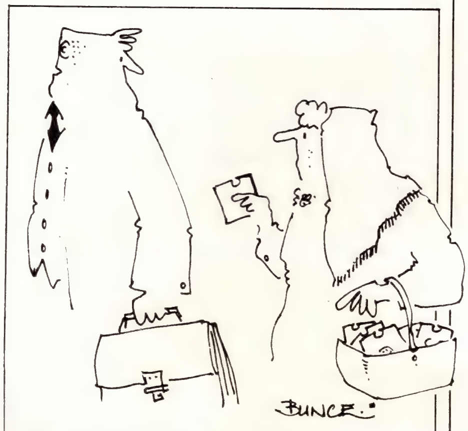
giving the following table:

0.	File no.	2	3	1
1.	Record row	1	0	7
2.	Record row	0	4	6
3.	Record row	2	1	3
4.	Record row	2	3	2
5.	Record row	3	1	5
6.	Record row	0	0	0
. . .	. . .	. . .	. . .	. . .
n.	Record row	0	0	0

Output

The output program recognises all three columns but, of them, only rows 3, 4 and 5, these being the only rows which are completely non-zero. It then seeks the records in each row, first requesting identification of fields to be printed. The results written are as follows:

Sname	:	Smith	Smith	Perez
Mname	:	Armchairs	Cupboards	Armchairs
Mquality	:	5	5	4



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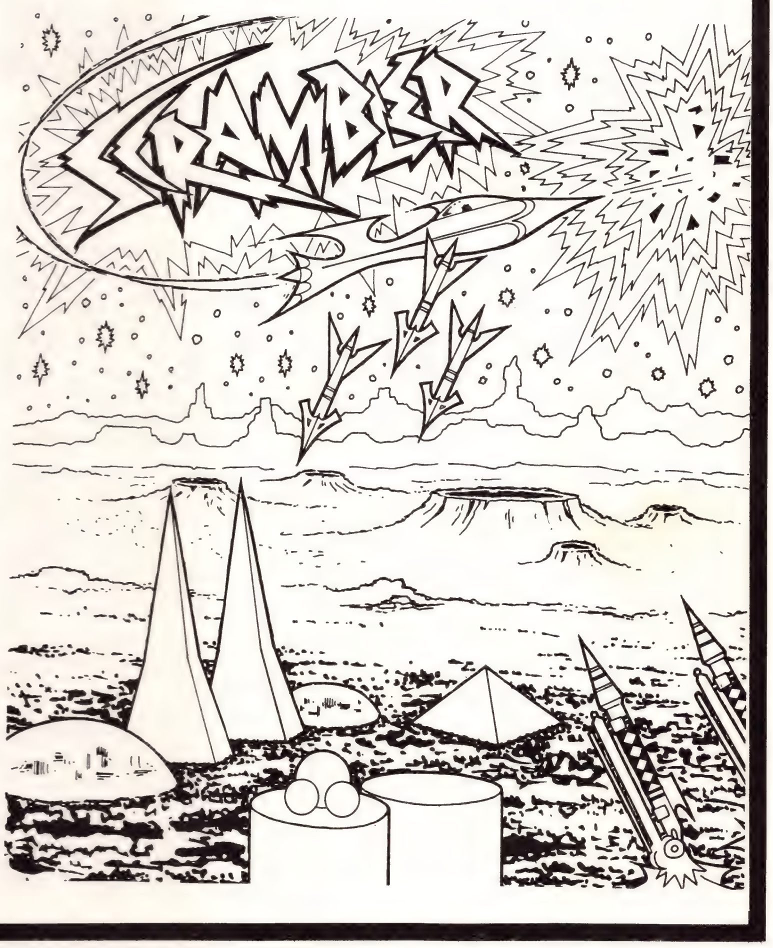

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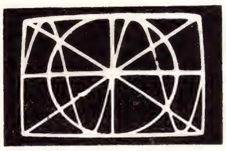

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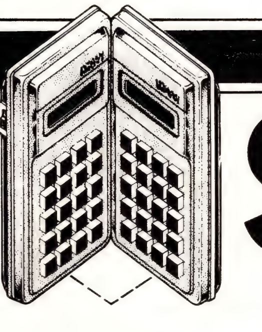

CALCULATOR CORNER

SHARP TIPS

Some useful programming tips for the Sharp PC1211 or Tandy Pocket Computer

After my prolific writing of the last few months I'm taking a bit of a rest this issue and handing the column over to Simon Maycock. Simon has sent in some programming hints for the Sharp PC1211 – or, to be more exact, for the Tandy Pocket Computer, which is what he owns.

Seeing his piece reminded me that I have somewhat neglected this machine in the last year; the introduction of the PC1500 in no way diminishes its interest as there must be an awful lot of units out there in either the Sharp or Tandy guise. The tricks presented here allow proper multi-record data files to be handled and also provide an insight into the way that PC1211 Basic is tokenised in memory.
Dick Pountain

The PC1211 has the useful facility of being able to GOTO a label, eg,

```
10 GOTO “L1”
20 . . . . . .
30 “L1” :. . . . . .
```

This may be used advantageously in several situations.

The first arises in the context of performing different actions depending on the value of a string, eg,

```
10 INPUT “ INSERT(I),DELETE(D),
   END(E) ?” ; Q$  : GOTO Q$
nn “I”    : . . . . . . GOTO x
mm “D”    : . . . . . . GOTO y
pp “E”    : . . . . . . GOTO z
```

In fact this is similar to the Pascal CASE construct:

```
10 READ (CH) ;
20 CASE CH OF
30 “I”    : . . . . . . ;
40 “D”    : . . . . . . ;
50 “E”    : . . . . . . ;
60 END; (* OF CASE*)
```

providing x, y, z are the same. Note a syntax error will occur if Q$ is given a value which is not used as a label name.

The second use is similar, ie, to access data embedded in the program body using a named selector. For example, to act as a portable phone or address book.

```
nn “I” : INPUT “NAME?”; N$
   GOTO  N$ (alternatively GOSUB N$)
mm “POLICE” : PRINT “ 999 ” :
   PRINT “ LOCAL = 3278 ” :
   GOTO “I” (or RETURN)
pp “DOCTOR” : PRINT “456789” :
   GOTO “I”
qq “. . . . . .
```

A syntax error will again occur if the name is not catered for; however, with such a limited memory a properly structured program, liberally annotated with comments is only normally attainable at the expense of variable space.

File handling

The cassette interface allows the computer to CSAVE and CLOAD named programs, also INPUT# and PRINT# are provided, allowing the memory variables A(1) or A$(1) up to A(n) to be saved and loaded from tape. n depends on the program size and is typically 130.

An optional part of these instructions is from what memory to start the output, input – eg,

```
INPUT# “DATA1” ; A(30)
```

will load the internal memory from A(30) upto A(n) with the data file “DATA1” on the tape.

An obvious consequence of the '. . . up to A(n). . . ' is that if only a few variables are to be saved then it is not sensible to put them in the low numbered memories, as the rest of the memories will be dumped onto tape as well.

One way round this is to maintain a pointer in the program which is initialised to the top of the variable memory space and as successive variables/data are created the pointer is decreased, then when the memory is dumped onto tape the value of the pointer is specified so that only the required memories are saved.

For example, details of a bank account could be saved in blocks of five memories

A(x) = cheque number
A(x+1) = value
A(x+2) = date (dd.mm so that days and month can be separated using INT)
A$ (x+3) = comment1
A$ (x+4) = comment2

In the following procedures T denotes the top of the memory; its value (a multiple of five) can be determined when the program has been written. P is the pointer, it is intialised to T, and as successive records are created it is decremented by five. All the variables A to Z are preserved.

```
10 T=. . . . . . :P=T
20 REM INPUT RECORD
30 “Y” : IF P = 30 PAUSE “NO MORE
   SPACE” : GOTO “DUMP”
40 P=P—5
50 INPUT “CHEQUENUM” ; A(P)
60 INPUT “VALUE” ; A(P+1)
70 INPUT “DATE(DD.MM) ” ;
   A(P+2)
80 INPUT “COMM1” ; A$(P+3)
90 INPUT “COM2” ; A$(P+4)
100 INPUT “CONTINUE (Y,N)” ;
   Q$ : GOTO Q$
110 “N” : REM LAST VALUE
   INPUT
120 “DUMP” : PRINT “TAPE ON
   REC”
130 PRINT# “DATA” : A(P)
```

The above 'Dump' routine does not record the value of P; this can be remedied by preceding 'Data' by a definition record, which contains the values of P (and can be extended to contain the date the file was created etc).

```
120 “DUMP”: PRINT “TAPE ON REC”
130 A(T)=P
140 PRINT# “DEFN”; A(T)
150 PRINT# “DATA”; A(P)
```

This duplicates A(T) but providing there is no more space after T the “DEFN” will be a very short file.

An appropriate read program could be:-

```
10 “READ”: PRINT “DATA TAPE ON
PLAY”
20          INPUT# “DEFN”; A(T)
30          P=A(T)
40          INPUT# “DATA”; A(P)
```

Note that these two routines effectively reverse the order of the records in the memory – if the order is important this can be overcome by using the Basic equivalent of a Downto loop in the processing program:

```
FOR I=P TO T—5 STEP 5; REM
PROCESS IN REVERSE ORDER
FOR I=T—5 TO P STEP —5; REM
PROCESS IN ORIGINAL ORDER
```

The above ideas have been successfully used in a series of programs to produce and maintain a record of a current bank account, and calculate balances and trends.

Another interesting point is that when programs are written the memory space for use as variables is gradually reduced. However, if program lines are deleted then these memories become available again. Looking at the contents of these memories reveals that they are full of apparent junk and non-numeric symbols. However, by typing characters into lines of programs, then deleting, and then finding the highest memory available ((A(n)) it can be seen that this 'junk' contains an itemised copy of the line. (Reading from right to left). The character set seems to be in some form of hex, since the following sequence commonly occurs:-

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, ., E, %, ¥, $, „,
the alphabet is itemised as follows:-
A=51, B=52. . . . . . I=59, J=5., K=5E, L=5%
M=5¥ (this symbol produced when shift Y is entered), N=5$,
0=5π, P=60. . . . . . Z=6.

All the other symbols have a representation, and Basic commands also have a code – eg:

PAUSE = ¥.
PRINT = %1
GOTO = ¥7

As an example: if NEW is entered, then CLEAR (in PRO mode) A(204) is the highest memory, so if 10:PAUSE A is entered, then 10 is entered (to clear line 10), examining A(204) gives 0.00015.¥01

Since the code for A=51, PAUSE=¥., we can split the line up:

0.000 15 .¥   01

shows these itemised (in reverse order) with the line number at the 'front'.

This is the only explanation I can conceive for this 'junk' and I would appreciate anybody enlightening me further.

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BENCHTEST PERSONAL COMPUTER

AFFORDABLE HP!

Dick Pountain checks out the HP-86, a lower cost addition to HP's 80 series of personal computers.

There is much excitement in the hi-tech halls of Hewlett Packard about a new product, the HP-86. Not because it represents any great departure in hardware terms from the established 80 series, but because for the first time HP has a personal computer which is priced to compete in the mainstream of the market place. HP has always been associated with high-priced high-quality products which have been bought largely by the scientific, engineering and other professional communities on reputation rather than cost considerations. The launch of the HP-125 business/management micro in 1981 broke new ground in using a non-HP produced processor (the Z80) and a non-HP operating system (CP/M) as an acknowledgement that these represent the realities of the current business micro market, but it is still priced well above the industry average and must sell on reputation and its advanced ergonomic features.

The HP-86 takes a further step toward the deep end. It is nominally part of the 80 series of laboratory and professional microcomputers but it can be expanded with a Z80 module to run CP/M. Most significantly, though, it is priced at a level which competes directly with Apple III and various other machines in the middle range at around $5000 for a 64k, twin disk system with printer. This is still someway above the $3000 typical of the keenest CP/M systems, but the 86 does offer graphics facilities which are either unobtainable or extremely costly on such machines. It demonstrates a new commitment by HP to compete in the hurly-burly of the volume micro-market, and to achieve this by up-to-date production engineering techniques. The design features of the 86 are closely based on the HP-87 introduced earlier this year, and the two machines are fully software compatible; the 86 is at least $1700 cheaper for a comparable system due to cost cutting exercises.

Hardware

The 86 is a 'separates' system, comprising keyboard/processor console, which is a departure from the 80 series philosophy of small integral VDUs.

The computer unit is cased in the traditional HP textured grey ABS plastic. At the rear of this case are three multi-pin connectors for two disk drives and à Centronics parallel printer. Notice I didn't say HP-IB connectors because they're not: the disk ports are dedicated interfaces for special HP peripherals, and HP-IB if required is an optional expansion. Moving across, we come to four edge-connector slots which can house a ROM drawer for certain firmware expansions, extension RAM modules, interface boards (such as HP-IB/IEEE, HP—IL, RS232,BCD or GP—IO) and the Z80 CP/M module. Finally there is a phono-type video socket for a black and white monitor and the power socket, fuse and switch.

Removing the case top reveals the source of cost-cutting: the computer inhabits a single board about 8in square which contains 80k of RAM (in 64k and 16k chips) and 48k of ROM as well as the processor, HP's own 8-bit unit which can address up to 640k via a paging system.

This main board is completely covered by a perforated metal plate to shield R/F emissions, and the interior of the case is metallised for the same reason. There is much evidence of cost-conscious engineering with foil-tape cables and connectors; HP sources say that the board is constructed on a new automatic component insertion line. The keyboard occupies a second PCB and the power supply has a third small one. The key switches are robust sealed units, but it is slightly worrying that there is no sort of backing plate: you can see the underlying PCB through the gaps between keys and therefore also drop paperclips or coffee right into the works (the PCB is heavily lacquered which is some comfort).

The keyboard has four main areas: a qwerty alphanumeric section, a numeric keypad, a screen control pad and seven programmable function keys with their associated KEY LABEL key. The main keyboard area contains some special keys like RUN, LIST, TRACE/NORMAL, CONT, PAUSE and STEP which are used during editing and will be discussed more under software. The numeric keypad, to my delight, has *ALL* the arithmetic functions duplicated on it as well as the unshifted) and (symbols which makes it into a self-contained, one-handed calculator. It also has a RSLT key which recalls the result of the last performed calculation to the display. Keys are provided to clear the screen, clear to the end or to the beginning of the line, insert and delete characters (BACKSPACE is a destructive backspace while —CHAR removes the character under the cursor; it is good to have both). All keys repeat after a short depression at a brisk rate. There is no TAB key — one or more of the function keys being used for this function if required.

The enter key is called END LINE which I'll grant is a better name than RETURN or CR as this function is not merely carriage return but carriage return/line feed; it's a pity though that everyone can't agree to call it NEWLINE SINCE the ANSI standard seems likely to triumph eventually.

RESET perfoms a hardware reset without clearing programs in RAM. The CTRL key does not use the normal ∧ representation for control characters instead the first 32 ASCII codes appear on the screen as Greek, Scandinavian and assorted graphics characters.

The ROLL key reveals an interesting facility: the 86's screen memory normally holds 54 lines of text by 80 columns, of which either 24 or 16 lines are displayed (selected by the PAGESIZE command). ROLL and its shift allow you to scroll this window up or down through the text eventually returning to the starting point as if the text were written on a cylinder. This means you can, for instance, scroll upwards through a program listing. In fact the screen memory is shared between text and hires graphics. The default condition is 54 lines of text and 400x240 graphics and you can switch manually between text and graphics screens with the A/G key or in a program by the ALPHA and GRAPH statements. If, however, you declare ALPHALL then the whole of screen memory is given over to text (204 lines); similarly GRAPHALL gives 544x240 pixels of graphics. In GRAPHALL mode though it is not possible to enter any text at all to the screen; you can re-route it to the printer or a disk file if you wish.

I was deeply impressed by the ergonomics and the terminal facilities of this keyboard which are the best of any machine I have used; program entry and editing on it are a pleasure.

The monitor supplied was a 12in green phosphor unit made in Japan for HP. It displays only average sharpness and steadiness, though it is by no means bad; it does not have a green filter over the screen and as a result contrast in well-lit rooms is not as good as it could be. Interestingly it has video and audio inputs and outputs on its backplate, though the 86 makes use only of the video input, having its bleeper in the console section. Many other monitors would be suitable for use with the 86.

The HP 9130A disk drive is specially designed for the 86. It is much smaller than previous HP 5in drives in a neatly styled plastic case rather reminiscent of the Apple III drive. Like the latter it takes its power from the computer so that, thankfully, no extra power cord is needed. The firmware to drive two of these is contained in ROM in the 86 as standard (as is the printer driver for a dot-matrix printer). Each drive holds 270k formatted and (under Basic) has the user selectable skew-factor feature introduced by the HP-125. The disk format is compatible with the HP-87 (as are most features of the 86).

Software

The HP-86 comes with an extended graphics Basic in ROM. On power up the machine goes through self-test routines and then deposits you in Basic, without any sort of sign on message, merely the square non-flashing cursor. Of the 80k, 16k is used as video memory and a little is pinched by the operating system leaving 61k for the user on switching on — which is twice as much as most disk-based Basics leave you; it is in fact more than you will get on a 128k Sirius or Apple III with Basic loaded. In this state the machine is in calculator mode which is rather more than the usual Basic command mode. Calculations of any complexity can be carried out directly without the need to use PRINT. Variables may be assigned values which are available to programs by using CONT instead of RUN as well as to direct calculations. Because of the rather special way the keyboard works (see later) it is possible to stop a program, perform manual calculations and pass the results to the restarted program.

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HEWLETT PACKARD HP86

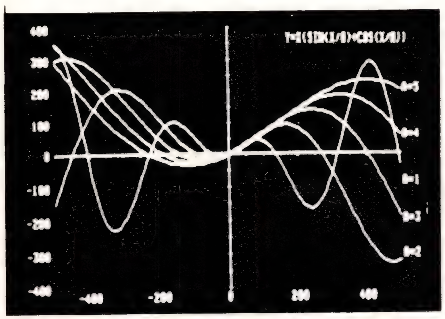
which should please physicists. The time to run Benchmark 8 is slower than average but bear in mind the above-average precision.

All entries to the computer are via an excellent full-screen editor which allows direct calculations as well as program lines to be edited; using ROLL you can edit and re-enter entries made 50 lines ago. A fine feature is that there is no READY prompt, just the cursor, so you don't get that infuriating syntax error if you CR through the prompt which most full screen editors give. AUTO, RENUM and DELete are all provided, plus a fine selection of debugging aids, most of which have their own keys. PAUSE stops execution until CONT is pressed. STEP single steps through a program. TR/NORMAL toggles trace mode, which can display not only line numbers but also selected or all variable values. LIST lists the whole program and displays the number of free bytes at the end. The remarkable thing is that most of the keyboard is active while a program is running; there is no need to hit PAUSE in most cases. You can for instance go straight into TRACE during a program run. Most keys when hit will pause execution; some, like KEY LABEL which displays the function key assignments, leave the program running and just do their thing.

Full syntax checking is performed as a Basic line is entered. Error messages are descriptive, not just numbers, and the cursor is positioned over the error. Programs should normally be initialised with the INIT key before running; this performs semantic checking (eg, FOR without NEXT, GOTO nonexistent line) as well as erasing calculator variables and allocating space for program variables. The latter is valuable if you're in any danger of running out of space and is not performed by RUN.

The editor keeps all spaces inserted between the line number and the first statement so that indentation can be used for readability; it also turns all reserved words into uppercase, however entered.

The Basic itself is not Microsoft based but close to the extended ANSI standard. For instance, string manipulation is by substring notation — eg, STRING$ [n,m] rather than MID$, LEFT$ and RIGHT$ functions. Strings must be dimensioned if longer than the default length of 18. 31 character variable names, all significant, are recognised and lower and uppercase are distinguished. REAL (12 digit, 12 byte), SHORT (5 digit, 8 byte) and INTEGER (5 digit, 7 byte) can be declared defaulting to REAL.



Axes are done automatically

The set of functions provided is more extensive than most Basics, including MIN,MAX,FLOOR and CEIL, INFinity and EPSilon (the largest and smallest machine numbers) in addition to the usual trig and logs.

A powerful aid to program readability is the provision of GOTO and GOSUB < label > instead of a line number; the labels follow the rules for variable names so you can say GOSUB Compute-Area or GOTO INPUTROUTINE. Remarks are prefixed with ! and may be added to the end of line; the editor preserves spaces between the last statement and ! so you can line them up nicely. A single line IF. . . THEN. . . ELSE and single or multi-line user defined functions are the only offerings made towards structured programs. Nevertheless, the proper use of all these features plus indentation makes for much more readable than average programs.

A powerful PRINT USING (and DISPLAY USING) statement is provided which uses IMAGE strings to control the output format of numbers. Long programs can be segmented and loaded from disk using CHAIN. Any variables which need to be passed between segments are declared as COMmon; the variable names need not be the same, only their order in the declaration list being significant.

Three types of interrupt can be handled by Basic. ON TIMER # allows one of three internal timers to cause program branching. ON KEY # causes programs to branch by pressing one of the function keys; it is also used in command mode to assign strings to these keys. When the computer is switched on they are assigned 14 Basic keywords (seven shifted), and these are not affected by any assignments made by a program, so there are effectively 28 functions. Finally ON ERROR /OFF ERROR permits error recovery. While on this subject, certain maths errors can be trapped by Basic itself — eg, underflow, overflow or division by zero. A default value (eg, INF or 99999999999999E+499) is taken, a warning is issued and execution is not halted. This condition can be overridden if required by DEFAULT OFF, in which case a normal error occurs.

The HP-86 graphics deserve a benchtest to themselves. They are lifted straight out of the 9800 series of benchtop 'microminis' and include the most powerful graph-plotting facilities to be found on a personal computer.

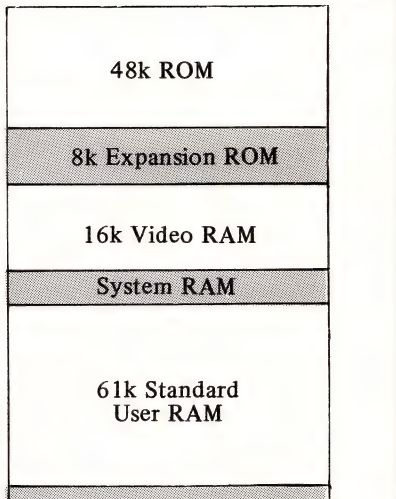
Anything which is displayed on the screen can be just as easily sent to a multipen plotter such as the 7049 by declaring PLOTTER IS and its device address.

Characters can be freely mixed with graphics on the high-res screen by incorporating the text into LABEL statements. Such characters can be printed in any size via the CSIZE statement which can also italicise and condense the letters. Labels can also be printed in any orientation using LDIR < angle >.

Any portion of the physical screen or plotter can be selected for plotting by LIMIT; within this area the LOCATE statement sets up a plotting area and scales it in Graphic Units so that there are always 100 GUs along the horizontal axis. These units can be overridden by User Units using the SCALE statement: eg, if you want to plot x from −200 to 200 and y from 50 to 300 then SCALE − 200, 200, 50, 300 does the trick, automatically converting to graphic units. MSCALE sets up a scale in millimetres for drawing office applications. Axes or grids can be drawn by the machine, marked with appropriate ticks using AXES or GRID. They can even be automatically labelled to the required number of decimal places by LAXES. a selected part of a graph can be cut out using CLIP and then blown up by changing the LOCATE parameters. Making certain LOCATE parameters negative will invert or reflect a plot while leaving the labels right way up.

These plotting commands are much harder to describe than they are to use. Suffice it to say that it is extremely easy to produce a graph with nicely labelled axes (with major and minor ticks) labelled with lettering following the slope of the graph and all automatically scaled so that no crashes occur due to plotting out of limits; and all this with about six lines of code.

Actual plotting of points is performed by PLOT in absolute screen coordinates, by IPLOT relative to the last point plotted or by RPLOT relative to a local origin which is moved by any pen moving command except RPLOT itself. All of these can take an optional para-



Memory map

meter which controls the raising or lifting of the pen. Lines are produced by DRAW (a relatively weak version which can only take two points as arguments; you can't draw a polygon with one statement) and MOVE, which moves the pen without drawing. WHERE X, Y stores the pen position and status in variables X and Y. If a plotter ROM and plotter are present you can use the plotter in reverse to digitise drawings by the DIGITIZE statement.

User defined graphic shapes can be created with BPLOT, which takes a string as argument and bit maps the shape from the decimal ASCII representation of each byte. The speed of plotting is sufficient for convincing animation to be done by MOVEing the pen between BPLOTs.

It is hardly surprising that the 86 contains 48k of ROM when you consider the amount of matrix arithmetic and such which must be contained in this remarkable graphics package.

If graphics are the strongest point of the 86 then the disk operating system is definitely its weakest. The publicity material describes 'easy I/O' facilities as an advantage; for some applications this may be true but for any data-intensive work it is frankly too simple. Random and sequential files are implemented in a straightforward way using CREATE to allocate disk space (the number and size of records is specified), ASSIGN# to allocate a file buffer and open the file. Data is transferred by PRINT# and READ#. Data of different types can be mixed in a file and the TYP function will return the type of the next record to be read. The allowed file types are DATA,PROGram,BPGM(binary program), and GRAF which contains stored graphics screens. Certain application ROMs can create other file types. When files are deleted using the PURGE command they remain in the directory as file type NULL and periodically you PACK the disk which sweeps away all these NULL files.

The first problem comes when you want to find out how much space is left on a disk. There is no utility equivalent to CP/M's STAT and the information is not given in the directory heading, which merely gives the volume name. To be sure, the directory gives the number of records and bytes per record for each file but I defy anyone to multiply and total these for a disk with 100-odd files. Fortunately DISK FULL is not a fatal error so the procedure is to keep going until you get this message and then change disks; you can format a new disk without affecting the contents of memory thanks to the ROM based operating system (it takes a reasonable two minutes).

This works but it is hardly elegant; so much better to have put the bytes free in the directory heading.

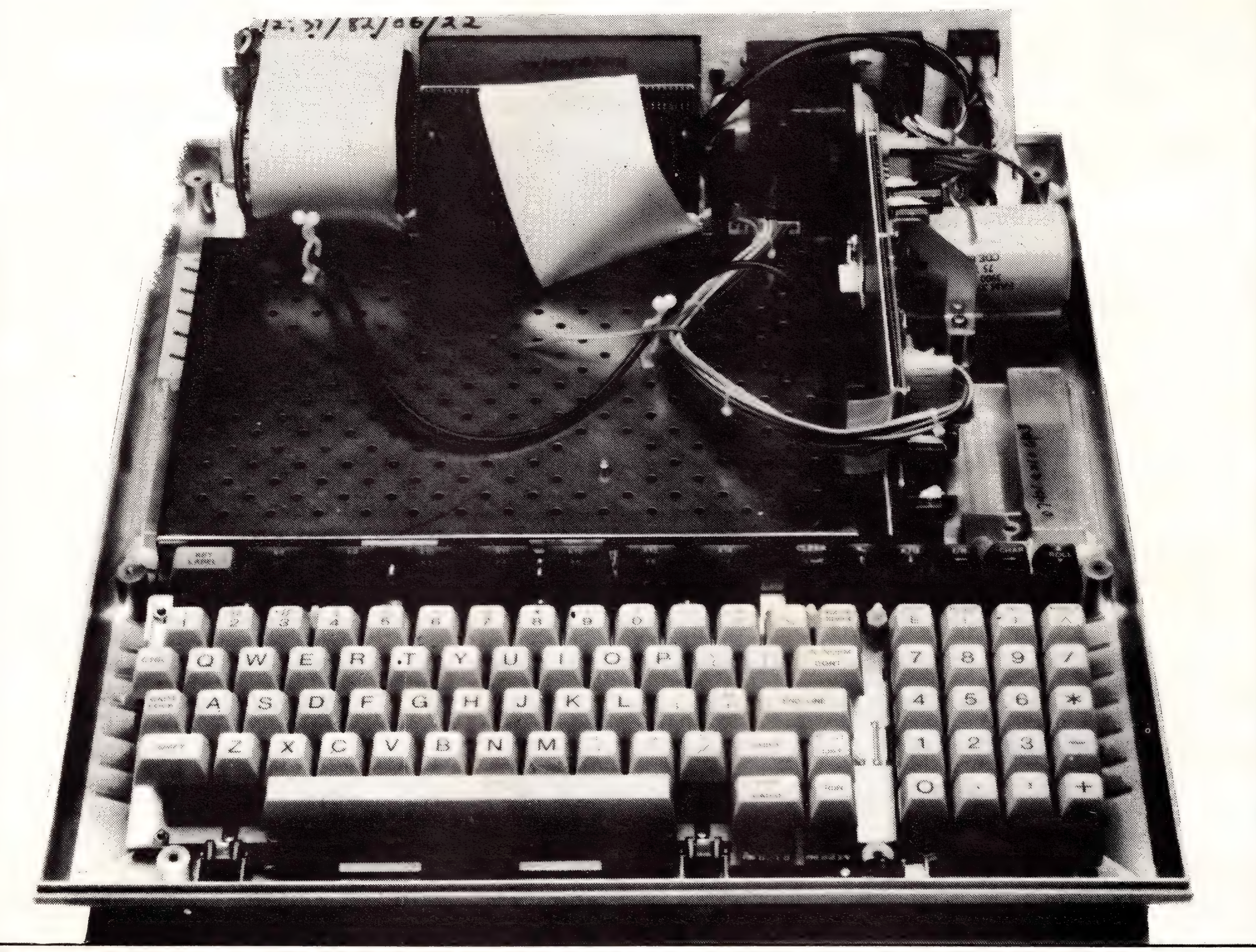
The next problem is that the command to copy files or whole disks only works with two drives. With only one supplied I couldn't backup any disks as the COPY command doesn't allow you to change disk; it searches for the destination volume and gives an error when it only finds the source. Again it would have been quite easy to have COPY prompt for number of drives and pause if necessary to allow a change. This is a real pity as the drives are not cheap and a single drive system would be very suitable for a lot of lab and workshop applications.

COPY doesn't allow wildcard filenames either; you can only copy single files or whole disks. In the latter case, the files are added to any on the destination disk rather than overwriting them.

The final irritant is that the operating system gives no prompt to signal successful completion of a program LOAD or STORE: the red light on the drive is the only sign that anything has happened; the cursor merely sits blandly on the screen doing nothing.

The operating system works perfectly well and will do most things you require, but in a fairly spartan and unfriendly way which contrasts strongly with the excellent ergonomics and utilities of the other subsystems.

As a final note on software, the 86 like the 87 contains a built-in translator which allows programs written on the 83 and 85 models to be converted and run. Anyone with either



The perforated plate is a Faraday cage to trap RF emissions of these models can thus upgrade without losing the use of their program library. It will not run 85 ROM software however.

Expansion and potential use

The HP-86 is capable of addressing a prodigious amount of RAM. Expansion modules can be had in 32,64 and 128k sizes and may be combined to a total of 576k user memory.

Similarly the ROM may be expanded by fitting a ROM drawer into one of the rear sockets which can hold six ROMs. The most likely first candidate is the Plotter ROM followed closely by the I/O ROM which adds routines to the Basic to handle instrument and control applications. An assembler is also available in ROM and an EPROM programmer.

A module containing a Z80 can be fitted to allow the 86 to run CP/M. This module totally disconnects the 86 processor and ROM, effectively turning it into a new computer; most of the advanced editing/debugging aids are disabled as are the function keys and the calculator mode. File formats are incompatible so there can be no transfer of data between HP Basic and CP/M. strong as Visicalc-PLUS is offered. One would treat the 86 as two different computers and use CP/M purely for word processing and spread sheet work. The Visicalc is a greatly enhanced version with extra maths and graphics capability, and with the full RAM expansion it can handle an enormous worksheet.

HP intends to implement the UCSD p-system in the near future and to offer the Pascal and Fortran, though I have no details of how it will be done (ie, will it be under CP/M?)

On the hardware side, an HP-IB module can be had which opens the 86 up to all HP's plotters,printers and instruments as well as to their other disk drives, 5in,8in and winchester. A very large number of these can be accommodated on HP-IB (40 5in drives or five winchesters!) if you can afford them.

The new HP-IL loop interface is also available to link the 86 to HP-41C calculators, tape drives, timers or other series 80 computers for data collection.

Any Centronics-type parallel printer can be used on the dedicated 86 printer port, though HP has simultaneously released a parallel version of its 82905 dot-matrix printer which can do graphics.

A 9in monitor is offered as an alternative to the 12in one tested. The library of ROM software for the 87 and 86 is now quite large though inevitably heavily biased toward scientific, statistical and engineering applications.

Who would use the 86? Despite HP's intention that this should be seen as a general-purpose computer it still has most appeal to the traditional HP customer in the laboratory and design office. The graph-plotting capabilities are so powerful that any application which doesn't require them is rather a waste of its talents. That's not to say that there aren't many management and educational applications which could benefit from these features. Nevertheless, I suspect that the 86 will mainly go into those regions of the scientific and engineering market which have been invaded by Apple and PET because hitherto HP was considered to be beyond the budget.

Does it make sense as a pure CP/M machine? You could certainly use it as a small business machine but there are plenty of cheaper CP/M machines to be had; moreover not to use the HP Basic would be rather like putting a Steinway in the public bar, — nice but rather extravagant.

In its ROM-based mode the 86 is very much a programmer's machine; everything has been done to make life pleasant for the owner who writes his own medium-sized but complex programs. As a personal computer on the lab bench it represents good value, since a single drive system could be had for around $5000 if you bought a cheaper monitor and an Epson MX-80 printer. It would be nice if they did something about the COPY command to facilitate this kind of use. There is plenty of scope for upward expansion from such a base system too.

It goes without saying that the 86 is not for hobbyists unless they be wealthy amateurs of science.

Documentation

The manual I was supplied with was for the HP-87 but since the only material difference is the shape of the screen (even the number of dots is the same) it will require only minor alterations. It is a large ring binder which has a first section of owner's information and abbreviated instructions for getting started, a section on HP-IB operations and then the 300-page Operating and Basic Programming Manual. All are written to the customary HP Standard; clear, readable and comprehensive with the exception that as normal there is no hardware information, not even a memory map. HP definitely does not approve of users wandering round through the innards.

The Basic manual has extensive tables at the end of key codes, expanded explanations of the 131 error messages and a list of the functions, commands and statements with syntax for quick reference. A full index is provided at the end.

As usual it is difficult to fault HP's documentation; maybe it could be done better but nobody does.

Prices (Excluding Sales Tax)

HP–86 Console	$2600.00
Monitor 9"	$425.00
12"	$470.00
Disk Drive 9130A	$1233.00
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Service contracts are available from $117.60.

Conclusion

Though it is still by no means a budget machine, the HP–86 represents a dramatic saving over the HP–87 and 85. A similarly configured twin disk system will be at least $1700 cheaper while having the same functionality. The disk drives, though much cheaper than previous HP models are still too expensive by half and bump up the system cost. With a bit of shopping around a single disk system could be built for around $5000 with a printer, though backing up data would be inconvenient. At these sort of prices it competes with Apple III, Sirius, IBM, Sharp MZ–80B and the larger Commodores as a laboratory tool. Its plotting facilities and arithmetic are very much more advanced than any of these machines in their standard forms, though it is less flexible in the range of languages available at present. It is nevertheless a welcome sign that HP is ready to do battle in the volume personal computer market and should keep the other manufacturers on their toes.

Benchmark timings

BM1	3.0
BM2	5.2
BM3	19.4
BM4	18.8
BM5	20.4
BM6	36.5
BM7	56.5
BM8	13.4

All timings in seconds. For an explanation of the Benchmark tests see APC Vol 3, No 9, September 1982.

'I think that's bloody mean — making the kids buy computer time out of their pocket money!'

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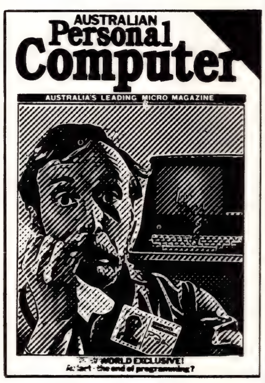

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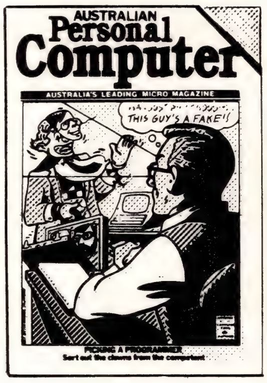
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- * Q — Go to decimal address.
- * G — Go to hex address.
- * R — Renumber a basic program.
- * E — Edit contents of I/O buffer.
- * B — Basic function. Includes:
    - (a) Protect basic program;
    - (b) Cancel protection. (Used in conjunction with renumber to merge programs.)
    - (c) Restore basic program after 'NEW'.

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APC-80 MON

by Geoff Lohrere

APC-80 Mon is a stand-alone utility for the TRS-80/System 80 computers. It resides in low RAM (to allow co-existence with APC-80) and provides a number of functions which are especially valuable during program development.

When run, the program presented in Listing 1 Pokes the necessary data into the low end of user RAM and automatically enters APC-80 Mon to display a screen driven menu. Included are such functions as displaying a Basic tape during loading, program protection and merging, listing variables in Basic programs, saving blocks of memory on tape (from which a System tape can be made of this program itself), editing and listing memory and program renumbering.

GETTING STARTED

Type in the Basic program shown in Listing 1 and save this version on tape. Restart the computer and key-in the following Pokes and type NEW to reset the 'beginning of Basic' pointers to a higher level, allowing room for APC-80 Mon:

Poke 19060,0 : Poke 16548,117: Poke 16549,74.

Next, load the Basic version back from tape and run it. A counter will appear in the top right hand corner of the screen indicating each of the 1900 (approx.) bytes as it is Poked into RAM. Immediately data is entered, the program should jump to APC-80 Mon and display a menu which makes available the following functions. (To revert to menu from most of the functions, hit 'Break' and from there hit 'B' to return to Basic. The menu can be returned at any time while in Basic by concurrently pressing the 'Shift', 'down arrow' and 'B' keys.)

Having put all the data in memory it's a good idea to make a System tape of APC-80 Mon to allow faster loading and program initialisation in future. To do this have a cassette ready in record mode and type C.

The start address requested is 42E8 and the end address, 4A74, with an entry point of 42E8. Any program name can then be given but I suggest APCMON. It is not necessary to hit the 'Enter' key after entering the name. To load this System tape in future, type 'System' and '/Enter'.

B – Returns to Basic from the APC-80 Mon menu.

D – Decimal Conversion.
This routine converts decimal numbers to their hex equivalent. It requires that five characters be entered so that figures with less than five digits will require leading zeros. Backspacing is allowed until the last character is typed.

H – Hex Conversion.
As above, but converts hex numbers to their decimal equivalent. It requires that four hex characters be entered.

L – Load Basic Tape.
Similar to normal CLOAD function but this routine mirrors displays of incoming bytes to the screen. It is very useful to check that 'good' data is being received and is a quick way of identifying unknown Basic programs.

P – Protect Program.
Just as three Pokes are required to transfer the beginning of Basic pointers to a higher position in RAM to allow APC-80 Mon to reside in low RAM, so this utility readjusts the Basic pointers to the top of the existing Basic program rendering it transparent to ROM Basic. The pointers can be returned to their normal position at the beginning of the Basic program by typing X. This also has the effect of merging the first Basic program with any program that has been entered while the first program was protected, so it's important to ensure that the second program's line numbers are higher than the first's before cancelling protection.

V – Display Variables.
A fairly ordinary feature but this routine will recognise all different types of variables that are distinguished by Microsoft Basic. So that 'A' and 'A$' will be listed separately, each variable is listed only once and the menu can be regained by hitting any key.

E – Edit/List Memory.
To display a block of memory, type four hex characters and the screen will display rows of RAM byte values (in hex). Each row contains 16 bytes which can be modified by typing E, to enter the Edit mode, followed by the required address from which to start editing. The value contained in this address will be displayed in brackets to allow verification that the correct byte has been chosen (hit 'Break' if you've got the wrong address).

To insert a new value into this address just type in the required hex value and (assuming the right area of memory is currently being displayed) the adjustment will be shown on the screen.

Fast scanning of memory blocks is made easy by simply hitting the down or up arrow keys to move up or down a screen-full of memory locations. Holding these keys down for any length of time will allow auto scrolling through blocks of memory. Hitting the 'C' key will alternate between ASCII or hex. The space bar will scroll the display one line at a time.

G – Goto Hex Address.
The routine transfers control to any point by typing in the required address in hex. The 'Enter' key is needed to transfer the program to that point and the routine can be aborted by hitting the 'Break' key.

R – Renumber Routine.
This is actually a stripped down version of Ian Davies' renumber program published some months ago in *APC*. It asks 1ST? (the first line number you want in the renumbered version) and INC? (the increment between line numbers wanted in the renumbered program). Each new line number is printed in the top right hand corner as it is created. Hitting 'Shift', 'down arrow' and 'B' will return control to the menu.

S – Program Restorer.
As in APC-80, this utility will restore a Basic program in memory which has been lost after NEW has been typed or where a less catastrophic crash has occurred.

X – Cancel Protect.
See Protect Program.

C – Saves a block of memory to tape.
Just type in the start, end and entry addresses followed by a six letter name. Saving starts automatically after typing the last letter of the name, so have your recorder ready in record mode. It can be used to make a system tape of APC-80 Mon as mentioned earlier in this article.

If you have any difficulties the author can be contacted on (03) 543 1485.

Listing 1

```
10 CLS:PRINT"LOADING APC-80 BASIC MONITOR";
20 READ H$:C%=C%+1:PRINT@56, C%
30 IF LEN (H$) >2 THEN 70
40 H%=ASC(LEFT$(H$,1))-48:
   IF H%>9 THEN H%=H%-7
50 L%=ASC(RIGHT$(H$,1))-48:
   IF L%>9 THEN L%=L%-7
```

```
60 POKE B%+O%,H%*16+L%: O%=O%+1: GOTO 20
70 IF H$="ORG" THEN READ B%: O%=0: GOTO 20
80 IF H$ <> "END" THEN STOP
90 MS =INT(17128/256): POKE16527, MS
100 LS =17128-MS*256:
    POKE16526, LS:X =USR(0)
 110 DATA ORG, 17128
 120 DATA 21,75,4A,22,A4,40,CD,4D
 130 DATA 1B,21,B4,48,22,16,40,ED
 140 DATA 7B,A0,40,3B,21,E2,48,CD
 150 DATA 75,2B,CD,49,00,FE,42,20
 160 DATA 06,CD,C9,01,C3,CC,06,FE
 170 DATA 43,28,39,FE,44,CA,C9,43
 180 DATA FE,45,CA,3D,44,FE,47,CA
 190 DATA F8,44,FE,48,CA,FB,43,FE
 200 DATA 4C,CA,03,45,FE,50,CC,C3
 210 DATA 45,FE,52,CA,D9,45,FE,53
 220 DATA CA,CC,45,FE,56,CC,6C,47
 230 DATA FE,58,20,B3,21,75,4A,22
 240 DATA A4,40,18,AB,31,88,42,21
 250 DATA 5B,4A,CD,A7,28,16,03,CD
 260 DATA 19,48,E5,3E,20,CD,3A,03
 270 DATA 15,20,F4,06,06,CD,49,00
 280 DATA CD,33,00,10,F8,CD,84,02
 290 DATA 21,64,02,22,01,40,3E,55
 300 DATA CF,21,2A,2A,22,3E,3C,06
 310 DATA 06,21,4F,3C,7E,23,CF,10
 320 DATA FB,E1,D1,E3,EB,ED,52,23
 330 DATA 7C,A7,06,00,20,04,45,B0
 340 DATA 28,1A,3E,3C,CF,78,CF,7B
 350 DATA CF,82,4F,7A,CF,1A,CF,81
 360 DATA 4F,13,2B,10,F8,79,CF,CD
 370 DATA 2C,02,18,DC,3E,78,CF,D1
 380 DATA 7B,CF,7A,CF,21,96,1C,22
 390 DATA 01,40,EB,CD,9A,48,C3,AC
 400 DATA 02,21,49,4A,CD,A7,28,CD
 410 DATA 9A,48,06,05,CD,24,48,CD
 420 DATA E0,43,CD,79,48,12,18,EF
 430 DATA 0D,11,00,00,7E,D6,30,83
 440 DATA 30,01,14,5F,0D,EB,C8,C5
 450 DATA 29,E5,29,29,C1,09,EB,23
 460 DATA C1,18,E9,21,37,4A,CD,A7
 470 DATA 28,CD,9A,48,CD,19,48,3E
 480 DATA 48,CD,33,00,CD,14,44,CD
 490 DATA 80,48,18,ED,EB,AF,ED,62
 500 DATA 01,00,10,AF,CB,13,CB,12
 510 DATA 7D,8F,27,6F,7C,8F,27,67
 520 DATA 79,8F,4F,10,EE,ED,5B,20
 530 DATA 40,13,E6,0F,C6,90,27,CE
 540 DATA 40,27,12,13,C9,CD,13,48
 550 DATA CD,C9,01,3A,40,38,E6,10
 560 DATA 28,04,11,20,FE,19,3E,0F
 570 DATA CD,33,00,3E,1C,CD,33,00
 580 DATA 06,0F,C5,CD,79,48,12,13
 590 DATA 13,13,13,13,06,10,3A,1A
 600 DATA 40,B7,20,10,7E,CD,8D,48
 610 DATA 78,D6,09,20,01,13,13,23
 620 DATA 10,F2,18,12,7E,FE,20,38
 630 DATA 04,FE,80,38,02,3E,2E,12
 640 DATA 13,13,13,23,10,EE,CD,9A
 650 DATA 48,C1,10,C6,3A,40,38,E6
 660 DATA 18,20,A8,3A,19,40,B7,20
```

```
 670 DATA 36,CD,A0,48,FE,0A,28,A2
 680 DATA 04,FE,20,28,AD,FE,45,28
 690 DATA 13,FE,43,20,99,3A,1A,40
 700 DATA 2F,32,1A,40,CD,C9,01,11
 710 DATA 10,FF,18,89,D9,21,19,40
 720 DATA 35,21,15,4A,CD,16,48,D9
 730 DATA 3E,1D,CD,33,00,18,E8,D9
 740 DATA CD,79,48,12,13,13,3E,3C
 750 DATA 12,13,7E,CD,8D,48,EB,36
 760 DATA 3E,23,23,22,20,40,06,02
 770 DATA CD,1B,48,EB,72,23,18,D7
 780 DATA CD,13,48,CD,A0,48,FE,0D
 790 DATA 20,F9,E9,21,21,4A,CD,A7
 800 DATA 28,CD,A0,48,CD,33,00,FE
 810 DATA 32,28,07,FE,31,20,EC,AF
 820 DATA 18,02,3E,10,CD,12,02,3E
 830 DATA 0F,CD,33,00,21,F0,41,11
 840 DATA 50,16,1A,E6,80,28,04,73
 850 DATA 23,72,23,13,7D,FE,E6,20
 860 DATA F1,CD,96,02,CD,35,02,FE
 870 DATA D3,28,F9,DD,2A,A4,40,21
 880 DATA 40,3C,06,04,CD,8F,45,10
 890 DATA FB,3A,40,38,E6,04,20,2F
 900 DATA CD,8F,45,B7,28,14,FE,80
 910 DATA 30,36,CD,B5,45,E5,DD,E5
 920 DATA E1,CD,6C,19,E5,DD,E1,E1
 930 DATA 18,DF,36,8A,CD,B6,45,36
 940 DATA 8F,CD,2C,02,CD,8F,45,06
 950 DATA 02,CD,8F,45,B7,20,C5,CD
 960 DATA F8,01,CD,49,00,18,3D,CD
 970 DATA 35,02,DD,77,00,DD,23,C9
 980 DATA E5,D6,80,87,26,42,6F,11
 990 DATA F0,FF,19,5E,23,56,E1,1A
1000 DATA E6,7F,CD,B5,45,13,1A,FE
1010 DATA 5E,30,9E,18,F5,77,23,7C
1020 DATA FE,3F,D8,7D,FE,C0,D8,21
1030 DATA 40,3C,C9,2A,F9,40,2B,2B
1040 DATA 22,A4,40,C9,2A,A4,40,74
1050 DATA CD,F8,1A,CD,59,1B,C3,F7
1060 DATA 42,31,88,42,21,3D,47,CD
1070 DATA 30,47,D5,CD,30,47,C1,D5
1080 DATA C5,7A,B3,28,EC,21,00,00
1090 DATA 54,5D,D9,2A,F9,40,22,DF
1100 DATA 40,2A,A4,40,2B,23,7E,23
1110 DATA B6,28,36,23,23,D7,20,0B
1120 DATA D9,23,D9,A7,20,F7,D9,13
1130 DATA D9,18,EA,CD,FF,46,20,ED
1140 DATA D7,CD,5A,1E,CD,0C,47,28
1150 DATA 0F,7B,02,03,7A,02,AF,03
1160 DATA 02,03,02,03,ED,43,DF,40
1170 DATA 2B,D7,FE,2C,28,E2,2B,18
1180 DATA CC,D9,2A,A4,40,5E,7B,23
1190 DATA 56,B2,28,28,D5,23,5E,23
1200 DATA 56,CD,0C,47,DD,E1,D1,20
1210 DATA 05,7B,02,03,7A,02,72,2B
1220 DATA 73,EB,D1,19,D5,E5,DD,E5
1230 DATA E1,18,DA,CD,F8,1A,CD,61
1240 DATA 1B,C3,CC,06,2A,A4,40,2B
1250 DATA 23,7E,23,B6,28,ED,23,5E
1260 DATA 23,56,E5,21,3A,3C,22,20
1270 DATA 40,EB,CD,AF,0F,E1,D7,A7
1280 DATA 28,E6,CD,FF,46,20,F7,D7
1290 DATA 30,F5,E5,CD,5A,1E,CD,0C
```

```
1300 DATA 47,0A,5F,03,0A,57,D5,EB
1310 DATA 2A,DF,40,E5,AF,ED,52,23
1320 DATA E5,C1,E1,54,5D,13,13,13
1330 DATA 13,C5,DD,E1,ED,B8,E1,D5
1340 DATA CD,9A,0A,AF,CD,34,10,B6
1350 DATA CD,D9,0F,C1,D1,23,C5,ED
1360 DATA A0,7E,A7,20,FA,C1,1B,D5
1370 DATA 13,C5,E1,E5,D5,EB,AF,ED
1380 DATA 52,23,23,23,D1,E3,23,DD
1390 DATA E5,C1,ED,B0,D1,2A,DF,40
1400 DATA 19,22,DF,40,2A,F9,40,19
1410 DATA 22,F9,40,E1,E5,D7,FE,2C
1420 DATA D1,28,94,EB,2B,18,87,E5
1430 DATA C5,21,49,47,01,06,00,ED
1440 DATA B1,C1,E1,C9,E5,D5,D5,C1
1450 DATA 2A,F9,40,ED,5B,DF,40,DF
1460 DATA 28,0E,79,BE,23,20,02,78
1470 DATA BE,23,28,07,23,23,18,EF
1480 DATA 3E,FF,A7,E5,C1,D1,E1,C9
1490 DATA CD,75,2B,E5,CD,B3,1B,CD
1500 DATA 5B,1E,E1,23,C9,1C,1F,31
1510 DATA 53,54,00,CA,1B,49,4E,43
1520 DATA 00,8D,91,CA,95,9F,8E,7E
1530 DATA 23,B7,28,1E,18,F9,7E,23
1540 DATA B7,28,17,FE,22,20,F7,18
1550 DATA 15,7E,23,B7,28,0C,FE,3A
1560 DATA 20,F7,18,0A,CD,C9,01,2A
1570 DATA A4,40,23,23,23,23,7E,23
1580 DATA E5,ED,5B,F9,40,ED,52,E1
1590 DATA 38,04,CD,49,00,C9,B7,28
1600 DATA E9,FE,22,28,C9,FE,88,28
1610 DATA D0,FE,93,28,BA,FE,FB,28
1620 DATA B6,FE,41,38,D9,FE,5B,30
1630 DATA D5,57,E5,DD,E1,DD,23,3E
1640 DATA 24,DD,BE,00,28,04,DD,21
1650 DATA 89,00,7E,B7,28,08,FE,3A
1660 DATA 38,08,FE,41,30,04,1E,20
1670 DATA 18,11,FE,5B,30,F8,FE,28
1680 DATA 28,F4,FE,29,28,F0,FE,2C
1690 DATA 28,EC,5F,E5,21,00,3C,01
1700 DATA FF,03,7A,ED,B1,E2,F4,47
1710 DATA 7E,BB,20,F6,23,0B,7E,DD
1720 DATA BE,00,20,EE,E1,7E,23,B7
1730 DATA 28,80,18,82,E1,7A,CD,3A
1740 DATA 03,7B,CD,3A,03,7E,23,B7
1750 DATA CA,72,47,7E,FE,24,20,03
1760 DATA CD,3A,03,3E,2C,CD,3A,03
1770 DATA C3,76,47,21,10,4A,CD,75
1780 DATA 2B,06,04,D5,CD,24,48,CD
1790 DATA 58,48,D1,C9,21,E0,42,E5
1800 DATA 3E,0E,CD,33,00,0E,01,CD
1810 DATA A0,48,FE,08,20,08,0D,28
1820 DATA F4,CD,33,00,2B,04,FE,47
1830 DATA 30,ED,FE,30,38,E9,FE,3A
1840 DATA 38,04,FE,41,38,E1,CD,33
1850 DATA 00,77,0C,23,10,D9,E1,C9
1860 DATA 06,02,CD,6F,48,07,07,07
1870 DATA 07,57,CD,6F,48,82,57,D5
1880 DATA 10,F0,D1,6A,D1,62,C9,7E
1890 DATA 23,D6,30,FE,0A,D8,D6,07
1900 DATA C9,ED,5B,20,40,13,3E,48
1910 DATA C5,F5,7C,CD,8D,48,7D,CD
1920 DATA 8D,48,F1,C1,C9,4F,0F,0F
1930 DATA 0F,0F,CD,32,44,79,CD,32
```

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1940 DATA 44,C9,3E,0D,CD,3A,03,C9
1950 DATA CD,49,00,FE,01,C0,3A,19
1960 DATA 40,B7,CA,F7,42,AF,32,19
1970 DATA 40,C3,CF,44,CD,BD,48,FE
1980 DATA 02,CA,F7,42,C9,21,36,40
1990 DATA 01,01,38,16,00,0A,5F,AE
2000 DATA 73,A3,20,08,14,2C,CB,01
2010 DATA F2,C5,48,C9,C5,01,00,06
2020 DATA CD,60,00,C1,0A,A3,C8,C3
2030 DATA FB,03,1C,1F,C1,41,50,43
2040 DATA 2D,38,30,20,2D,2D,20,42
2050 DATA 41,53,49,43,20,4D,4F,4E
2060 DATA 49,54,4F,52,DA,0F,56,45
2070 DATA 52,53,49,4F,4E,20,31,2E
2080 DATA 30,0A,0A,0A,C6,42,20,2D
2090 DATA 20,52,45,54,55,52,4E,20
2100 DATA 54,4F,20,42,41,53,49,43
2110 DATA CD,43,20,2D,20,43,4F,50
2120 DATA 59,20,4D,45,4D,4F,52,59
2130 DATA 20,44,41,54,41,0A,0A,C6
2140 DATA 44,20,2D,20,44,45,43,2E
2150 DATA 20,43,4F,4E,56,45,52,53
2160 DATA 49,4F,4E,CD,45,20,2D,20
2170 DATA 45,44,49,54,2F,4C,49,53
2180 DATA 54,20,4D,45,4D,4F,52,59
2190 DATA 0A,0A,C6,48,20,2D,20,48
2200 DATA 45,58,2E,20,43,4F,4E,56
2210 DATA 45,52,53,49,4F,4E,CD,47
2220 DATA 20,2D,20,47,4F,54,4F,20
2230 DATA 48,45,58,20,41,44,44,52
2240 DATA 45,53,53,0A,0A,C6,4C,20
2250 DATA 2D,20,4C,4F,41,44,20,42
2260 DATA 41,53,49,43,20,54,41,50
2270 DATA 45,CD,52,20,2D,20,52,45
2280 DATA 4E,55,4D,42,45,52,20,50
2290 DATA 52,4F,47,52,41,4D,0A,0A
2300 DATA C6,50,20,2D,20,50,52,4F
2310 DATA 54,45,43,54,20,50,52,4F
2320 DATA 47,52,41,4D,CD,53,20,2D
2330 DATA 20,50,52,4F,47,52,41,4D
2340 DATA 20,52,45,53,54,4F,52,45
2350 DATA 52,0A,0A,C6,56,20,2D,20
2360 DATA 44,49,53,50,4C,41,59,20
2370 DATA 56,41,52,49,41,42,4C,45
2380 DATA 53,CB,58,20,2D,20,43,41
2390 DATA 4E,43,45,4C,20,50,52,4F
2400 DATA 54,45,43,54,49,4F,4E,00
2410 DATA 1C,1F,48,45,58,20,41,44
2420 DATA 44,52,45,53,53,20,3A,20
2430 DATA 00,1C,1F,43,41,53,53,45
2440 DATA 54,54,45,20,31,20,4F,52
2450 DATA 20,32,20,3A,20,0E,00,1C
2460 DATA 1F,48,45,58,2E,20,43,4F
2470 DATA 4E,56,45,52,53,49,4F,4E
2480 DATA 00,1C,1F,44,45,43,2E,20
2490 DATA 43,4F,4E,56,45,52,53,49
2500 DATA 4F,4E,00,1C,1F,53,54,41
2510 DATA 52,54,2C,20,45,4E,44,2C
2520 DATA 20,45,4E,54,52,59,20,4E
2530 DATA 41,4D,45,0A,00
2540 DATA END
```

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Direct OA1000	M2
DTC Micro 210A	SC
Durango F-85	RL
Dynabyte DB8/2	R1
Dynabyte DB8/4	A1
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Exidy Sorcerer + Exidy CP/M 80 8in	A1
EXO	A1
Exxon 510	M5
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Findex	P6
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Heath H89 + Magnolia CP/M 80	P7
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IMSAI VDP-42	R4
IMSAI VDP-44	R5
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Intertec Superbrain DOS0.5-2x	RJ
Intertec Superbrain DOS 3x	RK
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MICOM3003	M1
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Monroe Discus	A1
Mostek	A1
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MAKING A HASH OF IT

Paul Overaa describes hashing, a fast file access method

In many applications it is necessary for sets of data items to be searched in order to rapidly locate an item or items of a specified value. Various approaches exist, including keeping indexes to locate the desired items, but this may require maintaining indexes of the key fields in sorted order so that techniques such as binary searching may be used. Although for some applications this is the best approach there are in many cases alternative solutions. One such alternative is known as 'key to address transformation' or 'hashing' and when used with care (ie, for suitable applications) it is possible to locate records in a fraction of the time that other methods will take.

In a general sense the problem is as follows: you wish to store data in such a way that given particular key fields you could retrieve other data items associated with the keys. As a concrete example, suppose you have a customer file containing records with the following fields or attributes:

CUSTOMER NAME
CUSTOMER ADDRESS
INVOICE ADDRESS
CREDIT STATUS
CURRENT CREDIT
DISCOUNT LEVEL

Given the customer name, you would wish to access the particular customer record in order to obtain the remaining details in the customer file. Let us suppose that it would be possible to find some 'rule' or 'function' that would turn the characters of each customer's name into a number each of which was unique and in the range of record numbers you had alloted for your customer file. The existence of such a rule or function would mean that given any customer name you would be able to compute the record number using only the rule. It would therefore be possible to store your records in locations that could subsequently be retrieved without any search at all simply by computing the location of the record from the customer name.

It is fairly obvious that in general no such rules exist, but if we relax the condition that our rules must produce unique numbers and instead be content with a situation where occasionally different keys will produce the same number then we are into the realm of hashing techniques or, as it is often called, key to address transformation techniques. When different keys result in the same hash value being computed then there is going to be a distinct probability that we will attempt to access a record that is not the one we require. Such occurences are termed 'collisions' and a discussion of how these are handled is important to the ideas that follow. If the hash function results in a collision then it is necessary to compute a 'second try' and maybe even further tries until the record we require is identified. In the worst possible case all records in the file would be examined before the correct record was located. Such occurences are extremely unlikely but. . . because it is possible at all it is necessary to make the following stipulation: any hashing rule used (and we now must include a method for calculating further locations to try in the event of collisions) must in the worst possible case be able to access every possible location available in the file. The frequency of collisions is related to the number of 'used' records in the file. It is a common practice to allocate some 20% more file space than an application requires since this helps to ensure that collisions are kept to an acceptable level.

Addition of data records would use the same rules and would search for the first location that was empty — ie, if the hash function located a record that contained data, then a second try, etc, would be made until an empty record was located. The new data would then be stored at this position in the file.

Circular files

The concept of a circular file is crucial to the approach I shall use to develop my ideas. I want you to imagine that the computer file is wrapped around a circle with the records of the file spread evenly around the circumference and that possible record numbers range from zero to (N-1).

Those that have studied any modern mathematics will appreciate the connection of my approach with the concept of 'clock arithmetic' — ie, arithmetic modulo N where N is the number of records in our 'Circular File'.

Our problems are as follows:

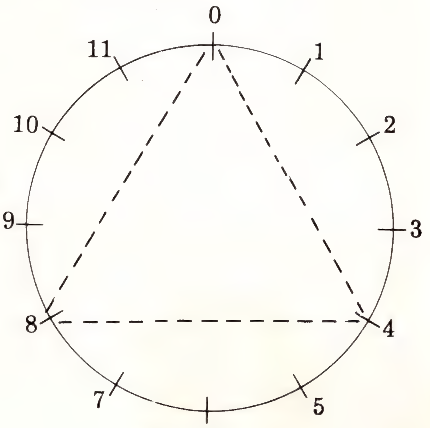
1. We require a rule that enables a record number to be calculated and a further rule that enables additional 'tries' to be calculated.
2. The rules must in the worst possible cases be able to search the whole of our circular file.
3. The rules must attempt, as far as possible, to distribute the data we store evently around our circular file otherwise there will be increased chances of collisions which will increase the time required to access a required record.

The most serious immediate problem is 2 — ie, how can we be sure that our circular file will be searched completely by any rule we could use? We could examine critically every rule that we invent and this approach has been used many times (it frequently results in some quite frightening mathematics) or we can make certain restrictions that will enable us to prove that in the worst cases we are in fact able to search the complete file.

The restrictions that I make are as follows:

1. Our hashing rules must produce two numbers, the first of which lies between zero and (N-1) and the second between 1 and (N-1) where N is the number of record positions in the circular file we are using.
2. The first number is used as the initial attempt value and the second number is used to 'step round' the file using a fixed step-length.
3. The size of the circular file is such that it contains N record positions where N is a prime number, ie, contains no factors other than unity or N itself.

The stipulation of N having to be a prime number enables us to state that any non-zero step length that is less than N will result in every location of the file being examined in the worst possible case. The proof of this is fairly straightforward and has an important corollary. . . namely that if you do not use a prime number sized file and the 'step-length' calculated has a common factor with your file size N then it will be impossible to search the file completely. To appreciate this image stepping around a file of twelve records using steps of 2,3,4,5,8,9 or 10 all of which have common factors with 12 and all of which will fail to search all of the 12 possible records.



Note: A step length of 4 results in only three records being examined irrespective of how many times we step around the circular file.

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MAKING A HASH OF IT

The calculation of a non zero step-length less than N provides a solution also to the problem of uneven distribution within the file since even if the initial record number produces a collision with another record it would be necessary for the keys to produce identical step lengths as well as before the same path would be followed for more than the first attempt.

At this time a rather important point to be made is that most computer systems do not allow zero as a valid record number. The solution in practice is simply to ensure that computed values are incremented by one, thus avoiding zero values.

Numeric Keys. . . here the problem is relatively straightforward. Suitable functions will depend on the range of values the keys will cover. A single example should indicate a typical method of solution.

The keys are stock numbers ranging from 00100 to 45200. There are approximately 600 different stock items and the wider range of stock numbers is the result of the numbers including check digits, storage area codes and spaces for further stock items.

In this case we could use a file size of say N = 997 and would define variables as follows:

Q = INT (STOCK NUMBER/N)
ENTRY POINT = INT(STOCK NUMBER − (N*Q))+1
STEP LENGTH = Q MOD(N−1) +1

Note that our definition of entry point ensures that we will obtain a number between 1 nad N similarly the definition of step length ensures a number usually different to the entry point and it will be between 1 and (N-1). (The above type of formula is very common and is able to produce good results in many cases.)

Alphanumeric/alphabetic keys. . . the additional problem is to convert characters into a pure number form before using an approach as for numeric keys. Some methods that may be used are as follows:

1. Convert each character of the key into the ASCII code equivalent then add or multiply them together.
2. Convert to ASCII code as in 1 above but weight each character by a number inversely proportional to its frequency in the language before adding or multiplying.
3. Only convert the consonants in the key to their ASCII equivalents and produce a numeric key from these.

Some procedures will be found to be better than others but in general you may assume that if your key domain is reasonably evenly distributed then most of the procedures will result in a similarly evenly distributed codomain (this is the set of numbers that the hashing function will produce!).

A typical application

Many simple applications are built around the three basic functions of addition of a record, deletion of a record and searching for a particular record. The example I have chosen was written to illustrate these functions in use is an 'address book' program. The idea being that you create records consisting of a name, two lines of address and a telephone number. The program enables you to locate these details using the name field only. The example is somewhat contrived but it does illustrate the basic ideas involved. Written in Microsoft's Basic 80 the program has the following layout:

A 'Begin Block' performs the setting up of variables and opening of a file. Variable N% defines the size of the file and can be altered to suit requirements. Two user defined functions are used: CLEARFROM$(X) is used to clear the screen from line X downwards. CUR$(X,Y) is used to position the cursor of the terminal. The cursor co-ordinates are supplied as column X (which may be between 0 and 79) and line Y (which may be between 0 and 23).

An 'Option Select' block enables the user to add, delete or retrieve data and to initialise the file by writing blank records. This block operates by selecting a subroutine based on the value of the option number selected. Files should be initialised before use since the program identifies unused records as those whose fields contain strings of blank characters.

Two subroutines called 'compute hash values' and 'compute rehash' respectively are used to perform the hashing functions. The name (the key field in this example) is converted to a numeric value which is the sum of the ASCII values of all the characters present. This field is brought to 20 characters in length so that proper comparison may be made with the name field retrieved from the random access file which will be 20 characters in length as defined in the FIELD statement (line 5010). The rehash subroutine increments the last record number calculated by the step length and line 4200 guarantees that we step around our

```
2 REM ========================================================================
3 REM           B E G I N  -  B L O C K
4 REM ------------------------------------------------------------------------
5 CLEAR
8 N%=113' IMPORTANT ----------------) User must set N% to a suitable PRIME NUMBER
10 DIM ADDRESS.LINE$(4),RECORD.LINE$(4),FIELD.NAME$(4),SELECTION$(4)
11 SELECTION$(0)="File full - cannot complete operations":SELECTION$(1)="Addition complete":
      SELECTION$(2)="Retrieval complete":SELECTION$(3)="Record deleted if key existed":
      SELECTION$(4)="All data erased - new file now available"
12 FIELD.NAME$(1)="Name":FIELD.NAME$(2)="First line of address"
13 FIELD.NAME$(3)="Second line of address":FIELD.NAME$(4)="Telephone number"
14 DEF FN CUR$(X%,Y%)=CHR$(126)+CHR$(17)+CHR$(X%+96-96*INT((SGN(X%-30)+1)/2))+CHR$(Y%+96)
15 DEF FN CLEARFROM$(X%)=CHR$(126)+CHR$(17)+CHR$(96)+CHR$(X%+96)+CHR$(126)+CHR$(24)
20 GOSUB 5000'open files
22 REM ========================================================================
23 REM          O P T I O N  -  S E L E C T I O N  - B L O C K
24 REM ------------------------------------------------------------------------
25 WHILE X%-5
30 PRINT FN CLEARFROM$(0)
40 PRINT FN CUR$(0,0);"1: Add"
50 PRINT FN CUR$(9,0);"2: Search"
60 PRINT FN CUR$(24,0);"3: Delete"
70 PRINT FN CUR$(38,0);"4: Clear"
75 PRINT FN CUR$(49,0);"5: End"
80 PRINT FN CUR$(60,0);"Which option ";:INPUT X%
85 ATTEMPTS%=0
90 ON X% GOSUB 1000,2000,3000,6000,150
92 PRINT FN CUR$(10,20);"Number of hash attempts required  ";ATTEMPTS%
95 PRINT FN CUR$(10,22);SELECTION$(X%);" press RETURN to continue";:X$=INPUT$(1)
100 WEND
130 REM =======================================================================
140 REM         E N D  -  B L O C K
145 REM -----------------------------------------------------------------------
150 END' -----------> This is the logical end of the program
970 REM =======================================================================
980 REM         A D D I T I O N  -  O F  -  D A T A  -  S U B R O U T I N E
990 REM -----------------------------------------------------------------------
1000 PRINT FN CLEARFROM$(8);:
1005 GOSUB 4500'Input routine
1010 GOSUB 4000'compute initial hash values
1020 WHILE RECORD.LINE$(1)<>STRING$(20,32) AND RECORD.LINE$(1)<>STRING$(20,ASC("*")) AND ATTEMPTS%<N%
1030 GOSUB 4200'compute rehashes until empty record is found
1040 WEND
1050 IF RECORD.LINE$(1)=STRING$(20,32) OR RECORD.LINE$(  STRING$(20,ASC("*")) THEN GOSUB 4900
      ELSE X%=0'store data if there is space otherwis    pare to give file full message
1060 RETURN
1970 REM ======================================================================
1980 REM         R E T R I E V L  -  D A T A  -  S U B R O U T I N E
1990 REM ----------------------------------------------------------------------
2000 PRINT FN CLEARFROM$(8)
2010 GOSUB 4600'input search key subroutine
2015 GOSUB 4000'compute initial hash values
2020 WHILE RECORD.LINE$(1)<>ADDRESS.LINE$(1) AND RECORD.LINE$(1)<>STRING$(20,32) AND ATTEMPTS%<N%
2030 GOSUB 4200'compute rehashes until correct record is found
2040 WEND
2050 IF ADDRESS.LINE$(1)=RECORD.LINE$(1) THEN GOSUB 4800
      ELSE PRINT FN CUR$(10,18);"This record does not exist - request has been ignored"
2060 RETURN
2970 REM ======================================================================
```

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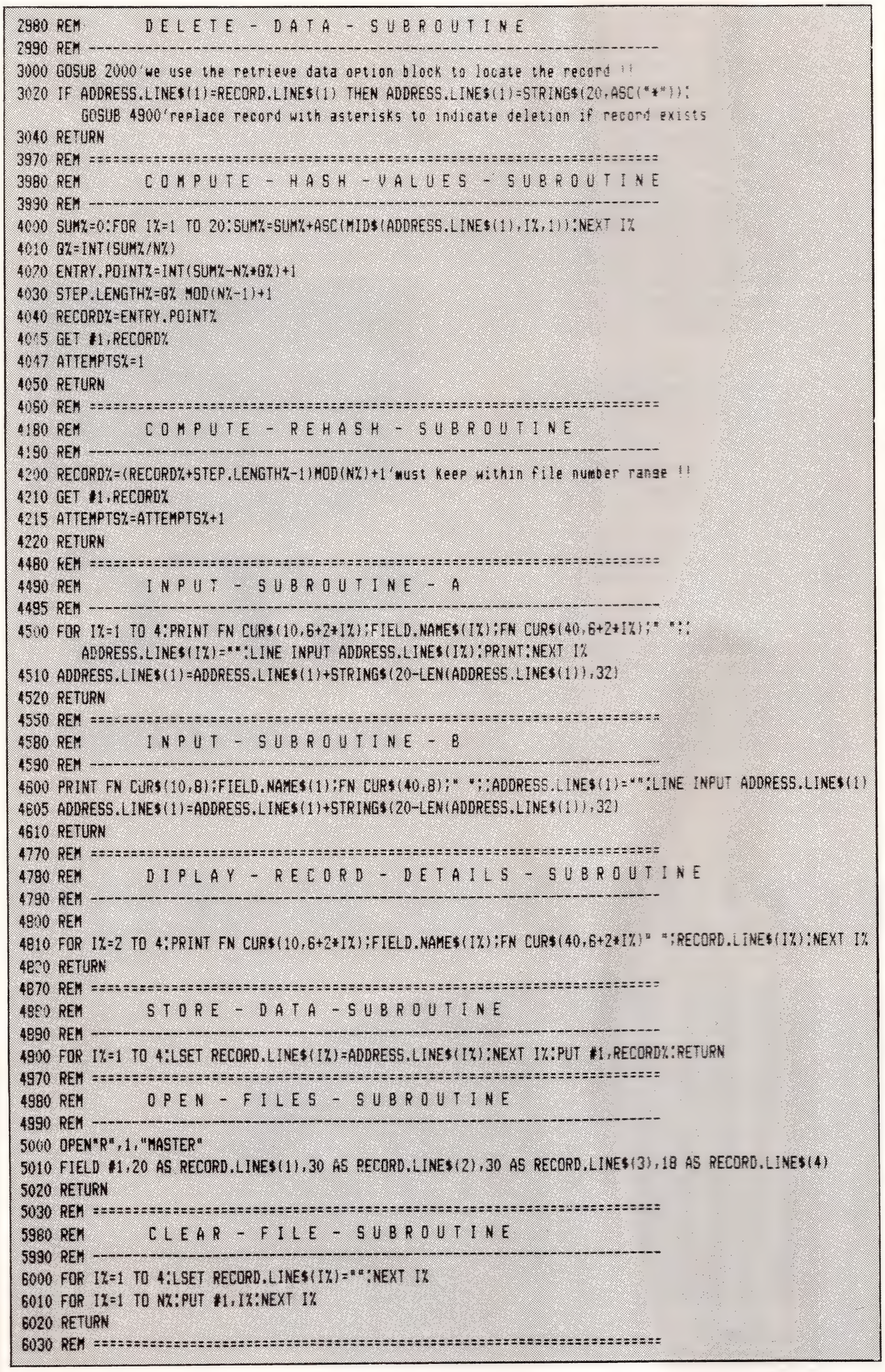

```
2980 REM       D E L E T E  -  D A T A  -  S U B R O U T I N E
2990 REM -------------------------------------------------------------
3000 GOSUB 2000'we use the retrieve data option block to locate the record !!
3020 IF ADDRESS.LINE$(1)=RECORD.LINE$(1) THEN ADDRESS.LINE$(1)=STRING$(20,ASC("*")):
      GOSUB 4900'replace record with asterisks to indicate deletion if record exists
3040 RETURN
3970 REM =============================================================
3980 REM       C O M P U T E  -  H A S H  - V A L U E S  -  S U B R O U T I N E
3990 REM -------------------------------------------------------------
4000 SUM%=0:FOR I%=1 TO 20:SUM%=SUM%+ASC(MID$(ADDRESS.LINE$(1),I%,1)):NEXT I%
4010 Q%=INT(SUM%/N%)
4020 ENTRY.POINT%=INT(SUM%-N%*Q%)+1
4030 STEP.LENGTH%=Q% MOD(N%-1)+1
4040 RECORD%=ENTRY.POINT%
4045 GET #1,RECORD%
4047 ATTEMPTS%=1
4050 RETURN
4060 REM =============================================================
4180 REM       C O M P U T E  -  R E H A S H  -  S U B R O U T I N E
4190 REM -------------------------------------------------------------
4200 RECORD%=(RECORD%+STEP.LENGTH%-1)MOD(N%)+1'must keep within file number range !!
4210 GET #1,RECORD%
4215 ATTEMPTS%=ATTEMPTS%+1
4220 RETURN
4480 REM =============================================================
4490 REM       I N P U T  -  S U B R O U T I N E  -  A
4495 REM -------------------------------------------------------------
4500 FOR I%=1 TO 4:PRINT FN CUR$(10,6+2*I%);FIELD.NAME$(I%);FN CUR$(40,6+2*I%);" ";:
      ADDRESS.LINE$(I%)="":LINE INPUT ADDRESS.LINE$(I%):PRINT:NEXT I%
4510 ADDRESS.LINE$(1)=ADDRESS.LINE$(1)+STRING$(20-LEN(ADDRESS.LINE$(1)),32)
4520 RETURN
4550 REM =============================================================
4580 REM       I N P U T  -  S U B R O U T I N E  -  B
4590 REM -------------------------------------------------------------
4600 PRINT FN CUR$(10,8);FIELD.NAME$(1);FN CUR$(40,8);" ";:ADDRESS.LINE$(1)="":LINE INPUT ADDRESS.LINE$(1)
4605 ADDRESS.LINE$(1)=ADDRESS.LINE$(1)+STRING$(20-LEN(ADDRESS.LINE$(1)),32)
4610 RETURN
4770 REM =============================================================
4780 REM       D I P L A Y  -  R E C O R D  -  D E T A I L S  -  S U B R O U T I N E
4790 REM -------------------------------------------------------------
4800 REM
4810 FOR I%=2 TO 4:PRINT FN CUR$(10,6+2*I%);FIELD.NAME$(I%);FN CUR$(40,6+2*I%)" ";RECORD.LINE$(I%):NEXT I%
4820 RETURN
4870 REM =============================================================
4880 REM       S T O R E  -  D A T A  - S U B R O U T I N E
4890 REM -------------------------------------------------------------
4900 FOR I%=1 TO 4:LSET RECORD.LINE$(I%)=ADDRESS.LINE$(I%):NEXT I%:PUT #1,RECORD%:RETURN
4970 REM =============================================================
4980 REM       O P E N  -  F I L E S  -  S U B R O U T I N E
4990 REM -------------------------------------------------------------
5000 OPEN"R",1,"MASTER"
5010 FIELD #1,20 AS RECORD.LINE$(1),30 AS RECORD.LINE$(2),30 AS RECORD.LINE$(3),18 AS RECORD.LINE$(4)
5020 RETURN
5030 REM =============================================================
5980 REM       C L E A R  -  F I L E  -  S U B R O U T I N E
5990 REM -------------------------------------------------------------
6000 FOR I%=1 TO 4:LSET RECORD.LINE$(I%)="":NEXT I%
6010 FOR I%=1 TO N%:PUT #1,I%:NEXT I%
6020 RETURN
6030 REM =============================================================
```

'circular file' in uniform steps. The variable ATTEMPTS% keeps track of the number of attempts that have to be made to locate the record and also serves to indicate when the file is full. When the file is full (ie, when the number of attempts equals the file size) the selection variable X% is set to zero to cause a file full message to be printed.

'Addition of data' is accomplished by collecting data with an input subroutine, computing the initial hash values for variables ENTRY.POINT% and STEP.LENGTH% and then stepping around the file using a WHILE/WEND loop until an empty record is found. Option 4 must be used initially to set up the data file by writing blank records. Once an empty record is found (or once all records have been looked at without finding any empty record) the loop is left and if there is available space the new data is stored.

'Retrieval' is performed by collecting the name to be searched for with the second input routine, computing the initial hash values as before and then performing a 'step-around' search using a WHILE/WEND loop as before. In this case the exit condition is based on three points:

First we may find a key match, ie, we have located required record. Secondly we may reach an empty record, in which case we will have searched all positions where the required record would have been placed. Thirdly we may have looked at all records in the file.

If the record has been located it is displayed by calling a 'Display Record Details' subroutine 4800 otherwise a 'does not exist' message is printed.

'Deletion' is accomplished by setting the name field of the record to a string of asterisks. The effect is to flag the particular record as deleted. Deletion is one of the areas that can provide difficulties since it is not normally appropriate to simply remove the details from the key field. If this were done then the deleted record would appear to be the 'end of the chain' as it were and the hashing search when reaching such a record would not look any further. This would cause improper searching and so a common solution is to set the key field to some arrangement of characters that can identify the record as being deleted rather than empty. The addition of data routine recognises deleted records by the fact that the key field, ie, the name field, has been set to a string of asterisks.

The remainder of the subroutines used are titled according to their function — eg, 'Open Files', 'Store Data' — and since each one has only two or three lines they should be self-explanatory. You will notice that I keep the individual parts of the program isolated by REM statements which include titles. This helps to split the program up into small units that are more easily understood. I tend also to treat these blocks as subroutines which are called as and when desired. This facilitates alterations, etc, and creates a more readable program. As an example, suppose you wish to change the way the initial hash values are calculated. The subroutine is identified easily by its title 'Compute hash values' and since it has only a few lines of code (which you will note could be written considerably more concisely than I have done for this example) it would only take a short time to understand what the subroutine is doing.

With properly designed screen layouts and the addition of input validation subroutines the program can be used for applications such as a 'computer diary', an 'attribute file', etc, but as a parting thought you may like to consider the following possibility:

An estate agents 'House for sale' file consists of houses that are classified by:

1. Cost Range eg, 20,000-29,999 : 30,000-39,000, etc.
2. Number of bedrooms.
3. Location with geographical areas being coded, say, using the postal code.

If a file was set up that used hash techniques to locate items based on a key produced from the three attributes mentioned and if, instead of storing the data in this file, you regard it as a directory with the file containing pointers to the heads of chains of 'linked' records then we produce what is termed a hashed access multilist directory.

All properties with the same 'attributes' are stored in chained form — ie, each record contains the record number of the next record in the chain. A search for 'all available property in area Mosman with four bedrooms and in the price range 45,000-49,999' can become virtually instantaneous. The three attributes produce a key that is hashed to rapidly find the 'head' of the chain records with these attributes and then all available property satisfying the criteria given can be retrieved with no further searching required at all.

It is difficult to do justice to any technique in an introductory article of this nature. I have illustrated the approach that I have developed but obviously there are an enormous number of other approaches. Once the basic ideas are understood the transition to more sophisticated applications becomes easier. In the end we are limited only by our own ingenuity. END

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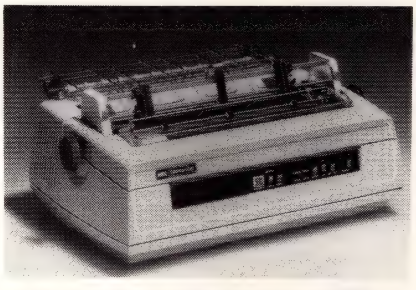

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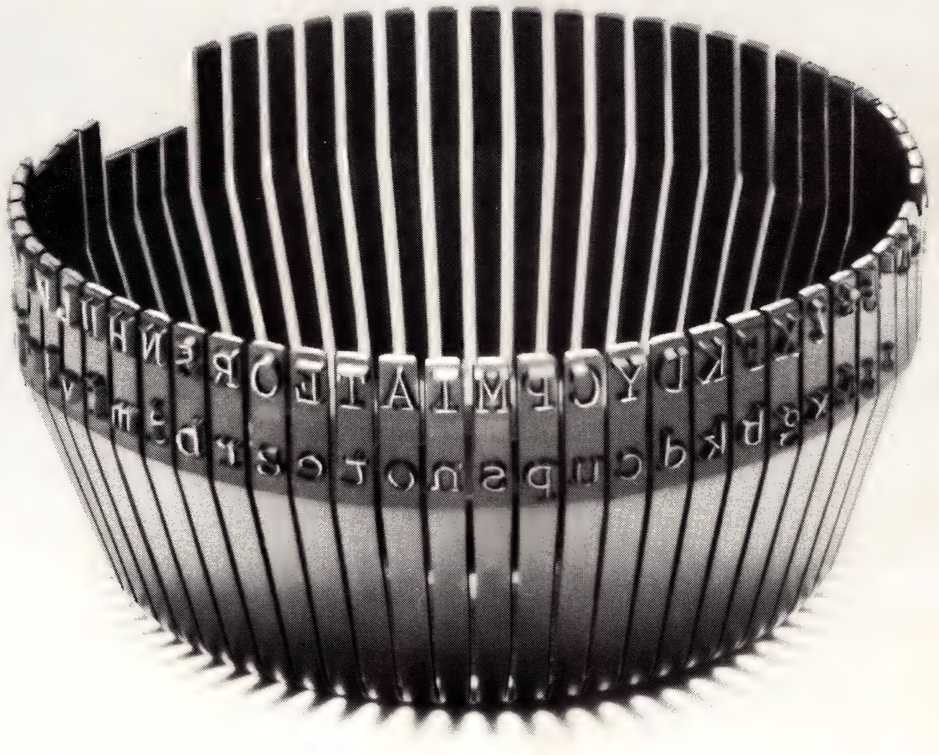

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NAMER OF THE NAMELESS

Dick Pountain writes on a little-known mathematical calculus which could have some importance for computing.

In 1969 I was a newly graduated biochemist with a keen intellectual interest in maths and philosophy and a keen practical interest in pharmacology. I shared a flat with several others of like inclination and this flat was filled with many esoteric books of great obscurity. One day I perused a book called *Laws of Form* by G Spencer-Brown. I was unable to understand it on that first reading and decided that it was probably cranky, like most of that mountain of books. It left an impression, though, and I never forgot it; I had a vague feeling that it might in fact have been profound, and felt a certain guilt at not having persevered.

Some eight years later I was flicking through my *New Scientist* when I came across a news piece: the Four Colour Map Theorem had been proved. This famous theorem of topology had resisted proof for more than a century and was a kind of Everest for topologists. It had been proved by one G Spencer-Brown using a fairly short and elegant proof. Around the same time a group of Americans reported a proof by a brute force method using some hundreds of hours on a fast mainframe computer. My mind was forcefully sent back to *Laws of Form* (which had long since disappeared along with several of the people). I scoured everywhere only to find that it had been out of print since that first edition. Eventually I found a mathematician friend who had a copy which he grudgingly parted with for two weeks. In those two weeks I read it again three times making some progress but still being very far from understanding it.

About this time my involvement with micro magazines began and I raved somewhat intemperately about the book to David Tebbutt one day. Some weeks later he returned from his first visit to the West Coast Faire and presented me with a brand new copy of *Laws of Form*. It is alive and well and published in paperback by Dutton of New York. According to David it has a certain following among the Artificial Intelligence community in Stanford.

I'm telling you all this to persuade some of you to seek it out and read it because of my faith in the personal computing idea; with so many people out there now possessed of computing power it is just possible that one of you might use the concepts contained in *Laws of Form* to stand computing on its head. I doubt that it will be me, unfortunately.

Laws of Form is about logic — sort of. In fact it is about something below or behind logic. Anyone who knows Basic knows something of the algebra invented by George Boole, though probably not in any rigorous or formal way. Boolean algebra is a notation which allows logical propositions to be expressed as algebraic equations, these being solved by a set of transformation rules to establish the truth value of the original proposition. In Basic it shows up as your AND, OR and NOT and those flag variables which only have the value TRUE (1) or FALSE (0).

Now algebras are abstracted from arithmetics (a+b=c expresses the form of all such arithmetic sums as 2+3=5, 4+5=9). But Boole's algebra was born fully grown as an abstract system to solve problems in logic. The lack of an arithmetic of which Boolean algebra is an abstraction went without notice for 120 years until G Spencer-Brown (aided by his late brother D J) produced this arithmetic. This is the subject of *Laws of Form*.

This arithmetic is non-numeric and is very simple indeed; so simple that it is extremely difficult to understand. That is not just a cheap paradox. Spencer-Brown (GSB from now on, begging his pardon) devotes a preface to warning of the difficulties in store for the reader; these are not due to any mathematical jargon, for the book is written in plain and nicely turned English and doesn't require formal maths training to read. The difficulty will be just as great for mathematicians as non-mathematicians because he is describing concepts which are almost too simple to be expressable in language. The notion of number and counting is formed very early in human beings (some people believe it's innate) and it is an obstacle to understanding concepts which are more primitive than itself. GSB's Primary Arithmetic is easier for amoebae than humans.

The argument starts from the idea of distinction. A distinction 'severs or cleaves' the space in which it is drawn, like the circumference of a circle in a plane. The space is now in distinct parts and one part can only be reached from the other by crossing the boundary drawn by the distinction. This act of crossing is given a symbol $\urcorner$ which is in fact the only symbol in the arithmetic. It represents the 'marked' state (a distinguished state). The unmarked state is represented by a blank space   . I should hasten to point out that GSB develops this rigorously. I'm cutting corners for reasons of space and pace.

Two laws, the law of calling and the law of crossing are taken as axioms and lead to a pair of primitive equations:2

$$\urcorner\,\urcorner = \urcorner$$

and

$$\overline{\,\urcorner\,}\big| =$$

and the calculus based on direct derivations from these equations is the Primary Arithmetic. Expressions made up of any number of these 'crosses' to any depth of nesting can be produced and simplified to give a value which is either $\rceil$ or . An example is

$$\overline{\overline{\rceil\;\rceil}|\quad\overline{\rceil\;\rceil}|}|$$

which has the value $\rceil$.

Small wonder that the opening page of *Laws of Form* contains a quotation in Chinese from the Tao Te Ching which goes 'The nameless is the beginning of heaven and earth. The named is the mother of ten thousand things.'

At this point you are probably wondering whether anything concrete can emerge from such a notation. Patience please.

Having proved a number of theorems in the arithmetic, GSB introduces variables or unknowns and so creates the Primary Algebra, which is by no means similar to Boolean algebra though it can be interpreted to give Boolean algebra and more by identifying cross with truth and blank with Falsehood.

An expression in the algebra looks like $\overline{\rceil\,a}|$ where the value of a is unknown. By deriving a series of nine consequences to which he gives significant names like 'reflexion', 'generation', 'iteration' it is possible to simplify such expressions though they do not always reduce to a known value.

The fireworks now begin. Boolean algebra is based on a set of postulates (ie, unproven assumptions), the exact nature of which set has been the source of much investigation. GSB proceeds to take one such set (Scheffer's Postulates) and prove them all in one page using the algebra. He goes on to demonstrate the interpretation of the algebra for logic. Massively complex syllogisms can be reduced to conclusions with astounding ease when compared to the laborious application of Boolean algebra and de Morgans theorems. At one point it is shown that all of pages 98 to 126 of Whitehead and Russell's 'Principia Mathematica' can be reduced to a single $\rceil$.

But the application to logic is a minor incident on the way. The Calculus of Indications, to give the system its full title, is of much greater generality than any logic.

In a breathtaking final chapter GSB introduces the idea of imaginary values by allowing the creation of re-entrant or recursive expressions. From this in a few short pages he produces expressions which demonstrate oscillating values, and can emit 'waves' which propagate through the space containing the expression. In other words, starting from two simple axioms and a simple notation he has produced expressions which can model the behaviour of the physical world of quantum mechanics.

In fact the calculus provides a general theory of forms which does not merely describe different forms but shows how they all emerge from the original form of distinction. Numbers and counting are derivable as interpretations at quite a low level.

At this point, having indicated just how far one could go with the calculus, he stops with what is perhaps my favourite sentence of all: 'This book is not endless, so we have to break it off somewhere. We do so here with the words

and so on.'

This last chapter contains the key to the solution of Boolean equations of the second and higher degree, which is the method the Spencer-Browns used to prove the Four Colour Theorem and which they put to practical use in designing complex switching networks for British Rail. I cannot pretend that I understand it well enough to either explain it here or to use it myself.

That then is a brief and clumsy account of the importance of *Laws of Form*. Why should *APC* readers be interested? For a whole stack of reasons, the first and best of which is that it is a challenging and exciting book, written with an elegance and wit which is almost extinct in modern science. If you like mental exercise this will stretch you even more than 'Godel, Escher, Bach' and with more immediately usable results.

The first project I thought of connected with microcomputing was the obvious one of writing a parser and evaluator to simplify expressions in the calculus. This is not at all an easy task because the calculus relies so heavily on the cross notation, which is simple and beautiful but highly unsuited to character-oriented micro displays. The trouble I had typing those examples above using Wordstar testifies to that. It's probable that you would have to reduce this notation to something rather like the nested brackets in Lisp to make it work; in fact all kinds of half-formed analogies with Lisp enter my head whenever I read the book.

But the really exciting idea which I can't shake off is that of a language which uses the Calculus of Indications in the place of Boolean algebra. Or, to go the whole hog, a processor with this logic implemented in silicon. I'm in way over my head with this sort of talk but everyone nowadays seems to be talking about non-von Neuman architectures as the next generation of machines; is it possible that higher order Boolean logics may have a role to play too?

At any rate I hope I can stimulate a few readers to find the book, read it, assimilate it (which will take about eight readings unless you're a lot smarter than me) and just maybe go on to do something amazing as a consequence. It is not as well known as it ought to be and it's nice to have a platform like this to boost it from.

PS. Professor G Spencer-Brown is alive and as far as I know well and living in Cambridge, England. Should he by any remote chance read this I'd like to apologise here and now for the rough-shod way I've trampled among his ideas.

(*Laws of Form* by G Spencer Brown — E.P. Dutton Paperback, New York 1978.)

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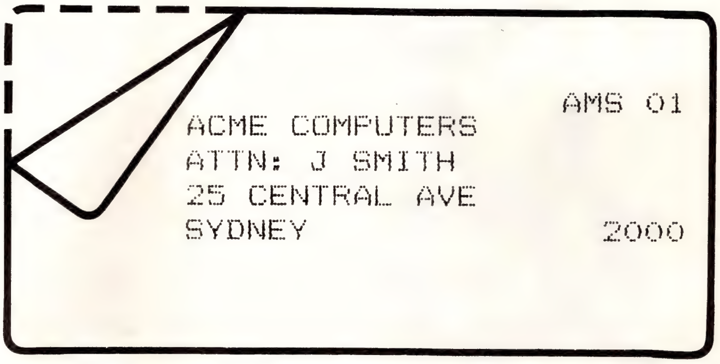

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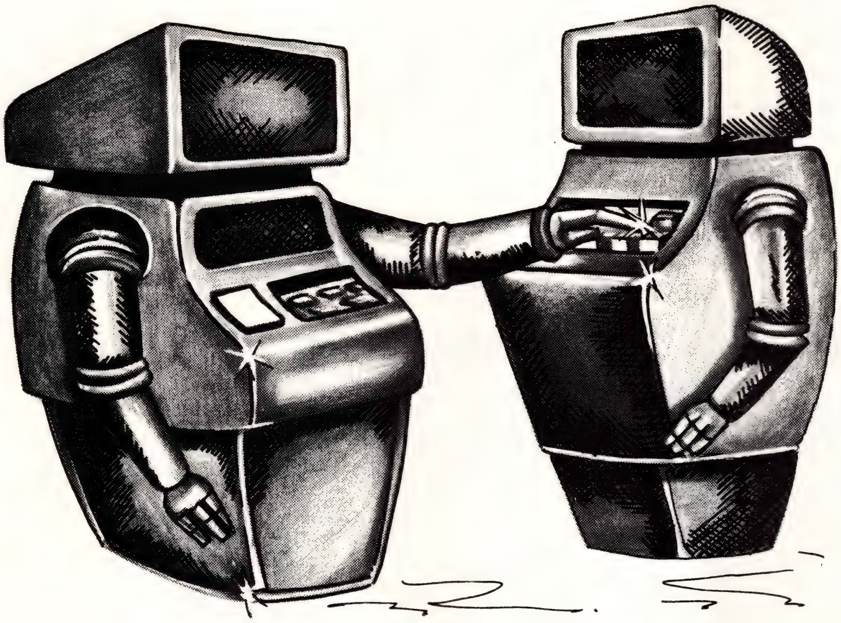


Part XII

HOW HIGH IS THE GROUND?

Steve Leibson concludes his series on computer input/output.

It is a paradox that of all the signal wires used in interfacing, the most complex is the one that seems the most simple.

Ground wires are usually ignored in the design of computers and interfacing circuitry. No signals are intentionally impressed on them.

Often, the number of ground wires in an interface cable is determined by how many conductors are left over after signal wires have been allocated. This type of interface design can lead to signal degradation, loss of data and even destruction of equipment.

Why do designers include ground wires in the first place? Electricity flows in loops. Current must always return to its point of origin according to the laws of physics.

If we want to send a logic signal to a peripheral device we will be sending it in the form of a current. This current must have a return path of low impedance so that the full signal strength is observed by the peripheral device. Any impedance in the pathways will diminish the signal observed by the peripheral.

One reason to provide a ground is to supply a low-impedance signal return path. This type of ground is called a logic ground because it is associated with the logic signals.

Plug problem

A second type of ground serves to ensure that the devices at either end are at or near the same potential. One of the "laws" of interfacing states that there are never enough sockets on a wall power outlet to supply a complete computer system. At least one device will be plugged into another wall outlet several feet away.

Most computer devices now are sold with three-pronged power plugs and use the third wire of the power outlet as an earth ground. This "earth ground" is used as a safety ground to keep the voltage of exposed metal parts within strict safety limits.

Unfortunately, due to haphazard wiring practices, there may be several volts of potential difference between the third wire of one electrical outlet and the third wire of an electrical outlet only a few feet away in the same room.

This potential difference is usually not large enough to pose a hazard to humans but can be death to a computer system. Signal levels for most interfacing systems today are five volts. A potential difference of only two or three volts can destroy all trace of a signal. A potential difference of twenty or thirty volts can destroy circuitry.

A safety or earth ground between devices can minimise this potential difference. Once again, we seek the lowest impedance possible so that the potential difference is as small as possible.

Ground tools

Now that we have good logic and safety grounds between our computer and our peripherals, we can relax, right? Probably not. Chances are we have created a ground loop.

Figure 1 shows a system with just such a problem. The computer and the peripheral are tied together with three grounds. There is a logic ground for the signal return, a safety ground for potential minimisation and the third wire grounds in the power cords.

The safety and third wire grounds are connected together intentionally. That loop cannot be avoided. The logic grounds in both devices are connected to third wire ground which is common in computer design. Loops are formed between logic and safety, logic and third wire and third wire and safety grounds.

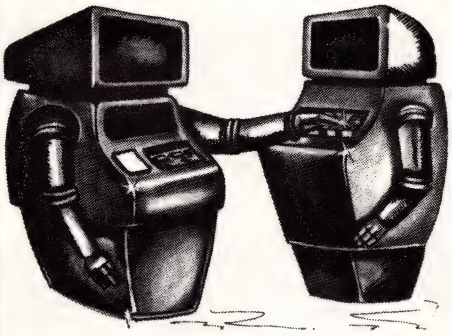
Two sources of problems exist for this system. First, current may be flowing in the third wire conductor due to a faulty or leaky device someplace else in the power system. This will cause a voltage difference at the two power outlets A and B. That is why we installed the safety ground, to add a low impedance path and minimise this difference.

The third path

The current sees the dual paths of third wire and safety grounds and the voltage difference will indeed be small. Unfortunately, the current will also see a third path to flow through, the logic ground.

Logic grounds are not typically designed to carry power fault currents. They have higher impedance. Thus a large current flowing through signal ground may prevent communications.

Since we put the grounds in to allow the logic signals to be received reliably, how do we prevent ground loops from destroying that reliability? The best method is to plug all devices in a computer system into one electrical outlet.



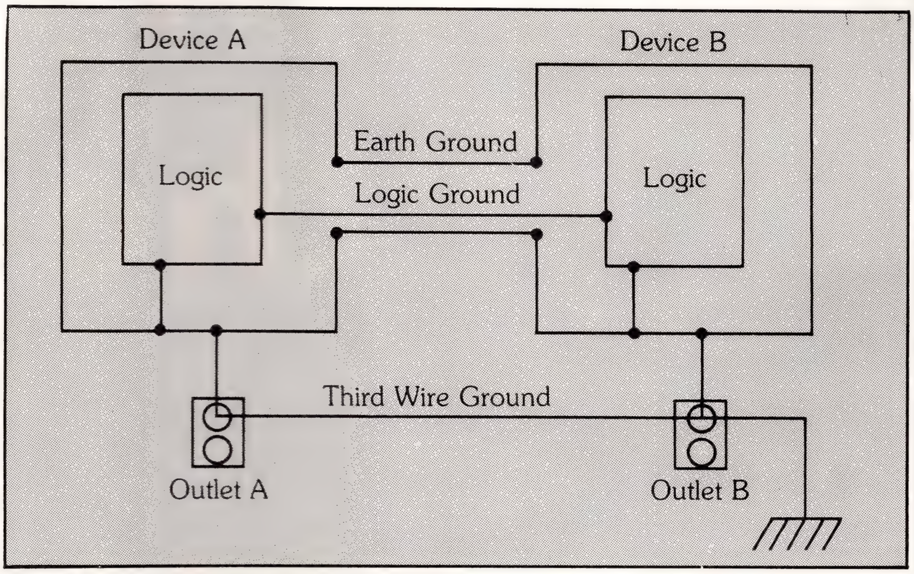


Figure 1

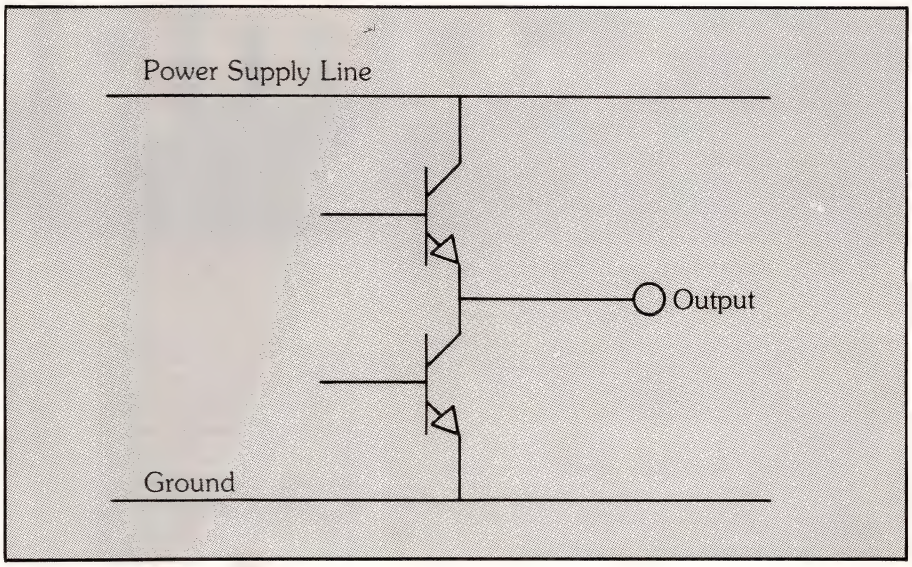


Figure 2

This assumes that there is enough current capacity on that circuit to supply the computer and all of its peripherals with power. If there are not enough sockets on the outlet, use a power strip. The third wire ground in a power strip is short, well defined and will be of low impedance.

EMI

Now that we have eliminated the effects of ground loops and our system is performing flawlessly, we can relax. Unfortunately, we notice that whenever the computer system is on, there is a lot of static on our radio. Worse, our neighbour down the hall notices the same effect on his or her radio. Welcome to the world of electromagnetic interference (EMI); the second problem in interfacing grounding.

Figure 2 is a picture of the output stage of a typical logic circuit. There is a transistor connected between ground and the output signal line and another transistor connected between the power supply and the output signal line.

If both transistors are turned on at the same time, a large current will flow and destroy the circuit. If only the top transistor is turned on, the output voltage will be close to that of the power supply. If only the lower transistor is turned on, the output voltage will be close to ground potential. The signal is switched by changing which transistor is on and which is off.

Computing antenna

When this switching takes place, both transistors will be partially on for a brief period of time. One is partially on, going off and the other is partially off but turning on.

At this instant, a large current is allowed to flow from the power supply to ground through both transistors. This current spike will make the ground jump a bit through the small but finite impedance of the ground line.

There are literally thousands of these output circuits in a computer, switching constantly. All are adding their share of noise to the logic ground. This noise is carried out to the interface cable and over to the peripheral on the logic ground wires we ingeniously ran between the devices in our computer system.

The voltage spikes in the ground are too small to affect the interface logic signals but the interface cable acts as an antenna and transmits this noise for all to receive. The thousands of output circuits team up to form a low voltage but high current signal. The actual logic signals are much lower current and don't cause as much trouble.

Solutions

There are two solutions to this problem. The first involves the use of low impedance ground planes in the computer and peripherals to minimise the ground noise. The second is to shield the interface cabling to prevent the noise from escaping.

Finally, interface designers are attacking the ground loop and EMI problems using a new interfacing technology; fibre optics. Glass optical fibres carry modulated light signals between devices. There are no grounds, thus no loops. There are also no "antennas" to pick up and transmit noise.

Currently, fibre optic interfacing costs more than the conventional interfaces we have covered in this series. Some applications requiring long distance or good noise immunity are already using this interfacing technology. Many more applications will use fibre optics in the future.

Steve Leibson joined the Calculator Products Division (now the Desktop Computer Division) of HP in June 1975. Since then he has worked on a variety of hardware and software projects, all relating to interfacing of desktop computers. His products include the 9878A I/O Expander, the 98036A Serial Interface, the 98224A Systems Programming ROM for the 9825A and the I/O backplane for the System 45.

In 1980 Steve co-authored a book: "The Great Small Business Computer Ripoff", with a close friend, Bill Scott. He has published the book himself by forming a small company called Data Press.

Steve now works for the Auto Trol Technology Corporation of Denver, Colorado.

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TJ's WORKSHOP

Our monthly pot-pourri of hardware and software tips for the popular micros. If you have a favourite tip to pass on, send it to 'TJ's Workshop', APC, P.O. Box 280, Hawthorn, Vic 3122. Please keep your contributions as concise as possible. We'll pay $25 for any tips we publish.

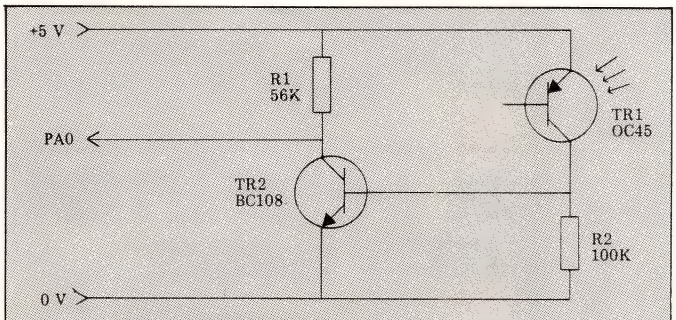
PET CAMERA TESTER

A microcomputer system is ideal for testing the shutter speed of a camera, the main requirement of which is to measure short periods of time, down to 1/2000 second, with a high degree of accuracy.

First, some sort of sensor is necessary to detect the shutter's opening. The obvious way to do this is by light, with a fairly powerful lamp shining into the open lens mount (it's better to remove the lens, if possible) and the sensor held as closely as is safely possible behind the rear of the shutter blind.

The sensor must be a phototransistor with no connection to its base. A photoresistor will definitely not do as its response times are far too slow. I used an old 0C45 from my junk box. Other phototransistors may be used, but the value of R1 in the circuit diagram may need altering. If you use an NPN phototransistor you must of course connect the emitter and collector the opposite way round.

A word about the lamp: don't make it too powerful and don't put it too close to the camera. When I put a photoflood right up next to my Yashica, I was horrified to see the plastic nameplate partially melting! That cost me $8 to fix.



NB: PA1-7 inclusive must also be grounded, as the program will only count when all lines are grounded.

Fig 1 The Circuit

```
      033A  SEI          78
      033B  LDA  $E84F   AD 4F E8
      033E  BNE  $033B   D0 FB      ; Wait for shutter to open
4     0340  LDA  $E84F   AD 4F E8
3     0343  BEQ  $0347   F0 02
      0345  CLI          58
      0346  RTS          60
5     0347  INC  $01     E6 01      ; Increment low order byte
2/3   0349  BEQ  $0351   F0 06      ; Branch through if low byte
3     034B  JMP  $034E   4C 4E 03   ;   clocked round
3     034E  JMP  $0353   4C 53 03   ; These jumps are a time delay
5     0351  INC  $02     E6 02      ;   and must not be delayed
2     0353  NOP          EA         ; Time delay - must be kept
3     0354  JMP  $0340   4C 40 03   ; Back to beginning of loop
```

Fig 2 The machine code program

```
10 POKE 49459,0 : REM Set user port to all inputs
20 POKE 1,0 : POKE 2,0 : REM Set counters to zero
30 PRINT "Ready to start"
40 SYS 826
50 T=(PEEK(1)+256*PEEK(2))/40 : REM Div by 80 if 2 MHz clck
60 PRINT "Time taken = ";T;" milliseconds"
70 PRINT "= 1/";INT(1000/T+.5);" second"
80 GOTO 20
```

Fig 3 Basic program

The software consists of a machine-level program resident in the second cassette buffer (which would need relocating on machines other than the PET) and a Basic program to control it and tabulate the results.

The machine code timer program is shown in Listing 1. The loop at $033B - $033E waits until the phototransistor is exposed to light. Once the phototransistor registers, the BC108 turns on and PA0 is grounded so the micro drops through this loop and starts counting. The counter is a simple two-byte counter, clocking continuously until the shutter closes. The complication is to make the routine take exactly the same time and exactly the same number of instruction cycles per loop whether or not the branch to increment the high order byte, $02, is taken. A bit of roundabout programming has neatly overcome this problem: 25 cycles (25 us with a 1 MHz 6502, 12.5 us with a 2 MHz chip) are taken in each case.

The number of loops made will be given by the Basic code PEEK(1)+256*PEEK(2). With only two bytes to hold the count, the system will clock round to 0 after 1.6384 seconds (half this with a 2 MHz clock) so times longer than that will read low by the same amount.

The rest of the Basic program should be self-explanatory. Dividing the figure obtained by the above expression by 40 (because each cycle takes 1/40000 second) gives a reading in milliseconds, and inverting that gives the nearest practical fraction.

I have used the system to measure speeds of both a Yashica FR and a Leica M3. I took 10 successive measurements and averaged them out, as is done by a leading photographic magazine. The results, although too long to publish in full here, make interesting reading. The Leica, the 'Rolls-Royce' of cameras, was less accurate by a factor of 2½ than the electronically timed Yashica. What is more surprising is that a camera a quarter of a century old should hold its own so well against a camera with technology so much newer and still provide a highly commendable set of figures, only 10 per cent out on average, even though it has never been serviced. That's why a Leica costs three times as much as a 'comparable' Japanese product!

The circuit and timer program should be easily adaptable to any other 6502-based machine; other processors will require a simple rewrite. And with different circuitry attached, the timer program must have a thousand other applications.

Kevin Jones

TJ's WORKSHOP

TRS-80 COMPUTED RESTORE

It is often useful to start READing data from a particular point rather than from the start of the DATA lists. This can be done by using RESTORE and then skipping over the unwanted data with a FOR-NEXT loop, but this is slow; if more data is added the numbers need to be changed.

This program allows you to specify a line number and, next time the READ command is used, the data assigned will be from that line (or the first line after it that has DATA). It is in machine code: to enter it simply type the three-line Basic subroutine shown in Listing 1 at the end of your program, and GOSUB 65520 at the start.

Then, to RESTORE at a line number, use the command DU=USR(X) where X is a line number and DU a dummy variable. X can, of course, be a constant, a variable or an expression, allowing the user to RESTORE at different line numbers depending on the value of the expression.

There are two limitations:

1) The line number cannot be greater than 32767; if it is this will result in an OV error.

2) If text entered in response to an INPUT command is over 205 characters long it will destroy part of the machine code program. It is very rare that such long inputs are needed: if they are simply add GOSUB 65520 after the INPUT command in your Basic program.

Briefly, the Basic program is scanned until:

a) the correct line is found;

b) the correct line is not found, so the next line after it is used;

c) the end of the Basic program is reached.

The data pointer (locations 16639 LSB/16640 MSB) is then set to the end of the previous line.

An assembly listing is provided which shows how it works in detail.

Steve Goldman

```
        ORG  17080                ;End of direct command RAM
RESTOR  CALL 2687                 ;Get argument (line no)...
        EX   DE,HL                ;...into DE
        LD   BC,17129             ;Start of Basic program
LINE    PUSH BC                   ;Store program pointer
        POP  IX                   ;  in IX
        LD   L,(IX+2)             ;Get current
        LD   H,(IX+3)             ;  line number
        OR   A                    ;Reset carry
        SBC  HL,DE                ;Comp current line no to
                                  ;  that wanted
        JP   P,COMP               ;If correct, go to adjust
                                  ;  routine
        LD   C,(IX)               ;Get next
        LD   B,(IX+1)             ;  line pointer
        LD   A,B                  ;If it isn't zero
        OR   C                    ;  loop to check
        JR   NZ,LINE              ;  next line
COMP    DEC  IX                   ;Point to end of last line
        LD   (16639),IX           ;Adjust data pointer
        RET                       ;Back to Basic
        END
```

Listing 2 Assembler listing

```
65520 DATA 205,127,10,235,1,233,66,197,221,225,221,110,2,221,
      102,3,183,237,82,242,216,66,221,78,0,221,70,1,120,177,
      32,231,221,43,221,34,255,64,201
65521 FOR L=0 TO 38:READ DA: POKE 17080+L,DA:NEXT
65522 POKE 16526,184:POKE 16527,66:RETURN
```

Listing 1 Basic subroutine to load machine code

SCREEN DUMP

This program written for System 80/TRS-80 16k Level II Basic machines will send the contents of the screen to a printer. The machine code is relocatable in memory by changing the value of the variable 'B' in line '20' of the listing.

Once run, a screen dump can be obtained by pressing 'Shift', 'Down arrow', and 'P', and can be terminated by holding the 'Break' key.

It is substantially shorter than the version you published recently – and doesn't have any bugs!

G Lohrere

```
10 REM BY G. LOHRERE
20 CLS:DEFINT A-Q :B=32512
30 PRINT"LOADING SCREEN DUMP ROUTINE"
40 FOR Q=BTOB+51:READ H$:A=A+1:PRINT@55,A
50 H=ASC(LEFT$(H$,1))-48:IF H>9THEN H=H-7
60 L=ASC(RIGHT$(H$,1))-48:IF L>9THEN L=L-7
70 POKE Q,H*16+L:NEXT Q
80 MS=INT(B/256):LS=B-MS*256
90 B=B+7:HB=INT(B/256):LB=B-HB*256
100 POKE17125, LB:POKE17126, HB
110 POKE16526, LS:POKE16527, MS:X=USR(0):END
120 DATA
   2A,E5,42,22,16,40,C9,CD,E3,03,FE,10,C0,21,9C,40,34
130 DATA
   E5,CD,FE,20,21,00,3C,0E,10,06,40,7E,CD,2A,03,23,10
140 DATA
   F9,CD,FE,20,0D,28,07,3A,40,38,E6,04,28,EA,AF,E1,35,C9
```

Basic Listing: Screen Dump

```
7F 00   2A E5 42   LD     HL,(42E5H)           7F 1C   7E         LD     A,(HL)
7F 03   22 16 40   LD     (4016H),HL           7F 1D   CD 2A 03   CALL   032AH
7F 06   C9         RET                         7F 20   23         INC    HL
7F 07   CD E3 03   CALL   03E3H                7F 21   10 F9      DJNZ   $-05H  ;7F1CH
7F 0A   FE 10      CP     10H                  7F 23   CD FE 20   CALL   20FEH
7F 0C   C0         RET    NZ                   7F 26   0D         DEC    C
7F 0D   21 9C 40   LD     HL,409CH             7F 27   28 07      JR     Z,$+09H ;7F30H
7F 10   34         INC    (HL)                 7F 29   3A 40 38   LD     A,(3840H)
7F 11   E5         PUSH   HL                   7F 2C   E6 04      AND    04H
7F 12   CD FE 20   CALL   20FEH                7F 2E   28 EA      JR     Z,$-14H ;7F1AH
7F 15   21 00 3C   LD     HL,3C00H             7F 30   AF         XOR    A
7F 18   0E 10      LD     C,10H                7F 31   E1         POP    HL
7F 1A   06 40      LD     B,40H   ;="@"        7F 32   35         DEC    (HL)
                                               7F 33   C9         RET
```

Source Code: Screen Dump

TJ's WORKSHOP

ZX81 KEYBOARD FEEDBACK

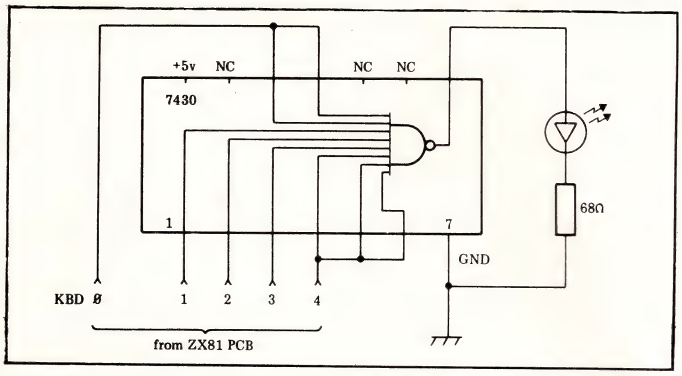
The lack of feedback on the original touch-sensitive ZX81 keyboard need no longer be a setback.

One LED, a 7430 chip and a few connections will give visual indication of any single key closure. The 7430's inputs monitor all five lines KBDO to KBD4 and a LED is lit as soon as a key is pressed. If the key is held down the LED stays lit. This feature is particularly useful for acknowledging SHIFT key closure.

A good place to mount the LED is on the sloping edge just below the lettering 'ZX81', as it is in our line of sight as we look down at the keyboard.

To give the modification a professional appearance a black plastic LED holder should be used. The power rails, ground and +5v can be taken from the holes next to the 7805 regulator chip (centre pin is ground and pin nearest PCB's edge is +5v).

Robin J D Cheng



A SINCLAIR UTILITY

I'm sure that many Sinclair users have the lines:

```
200 PRINT 'PRESS ANY
KEY TO CONTINUE':
210 IF INKEY$ = " " THEN
GOTO 210
```

or something similar, in many of their programs. However, the words 'ANY KEY' imply that both the shift & break key may be pressed. Anyone who has no ZX programming knowledge and is using such a program could either:

1. press shift — which would result in nothing happening at all, or
2. press break — which would result in the program crashing with report code D.

The latter could be disastrous. I have developed the following machine code routine which will suspend execution until a key is pressed — ANY KEY (literally) — and then will continue with the rest of the program.

```
16514: CALL 02BB  wait for
16517: INC H      key to be
16518: JRZ-6        pressed
16520: CALL 02BB  wait for
16523: INC H      key to be
16524: JR NZ-6     released
16526: RET   return to Basic
```

To load the machine code, enter the following program:

```
1REM 1234567890123
10 POKE 16510,0
20 LET A$ = "CDBB02242
8FACDBB022
420FAC9"
30 LET I = 16514
40 LET HI = (CODE A$ —28)
*16
50 LET LOW = (CODE A$(2)
— 28)
60 POKE I, HI + LOW
70 LET A$ = A$ (3 TO)
80 IF LEN A$ = 0 THEN GO
TO 110
90 LET I = I + 1
100 GOTO 40
110 PRINT "DELETE
THESE LINES"
120 PRINT
130 LIST 10
```

Then to use the program enter (for example at lines 200 - 210):

```
200 PRINT "PRESS ANY
KEY TO CONTINUE":
210 LET WAIT = USR 16514
```

instead of the lines shown earlier. The routine is fully relocatable and could be placed above ramtop.

S. Morley

BETTER RANDOMISATION

Here is a means of avoiding the prompt RANDOMIZE and its input response required by Microsoft Basic and some other Basics, while still providing fresh randomisation each time the game is run.

A sequential file is opened at the beginning of the program, from which an integer is retrieved, incremented and used as the seed before being rewritten to file. In Microsoft Basic-80 a suitable routine would be

```
10  OPEN "I",$1, "SEED"
20  INPUT $1,N
30  CLOSE $1
40  N=N+1
50  M=N
60  RANDOMIZE M
70  OPEN "O",$1, "SEED"
80  PRINT $1, N
90  CLOSE $1
. . .rest of program
```

The file "SEED" is initialised with the largest negative number that the system will support; in my case, —32767.

Theoretically, one should perhaps provide for re-initialisation when N overflows at +32768, but I doubt whether the average punter will live to see it.

If a disk contains more than one game you can incorporate this routine into the menu, so that all games share a common seeies of randomisation seeds and disk activity is reduced.

Simon Holmes

ZX81 EXTRA LINES

On the ZX81 it is possible to PRINT AT to the bottom two lines normally used for INPUTs. This is done by removing them from the INPUT cursors' use which at the same time frees them for use as lines 22 and 23.

These lines must be made available again if an INPUT is to take place or the program is to finish, otherwise the Interpreter will have nowhere for its cursor to go. POKE 16418,0 allows you to use the lines to PRINT. POKE 16418,2 restores the lines to be used for INPUTing.

WARNING!

In last month's TJ's we published a method to speed up the display on the PET ('Faster PET Screen', page 81). We have since been advised that on certain models this can cause serious damage to the video circuitry. Unfortunately there is no easy way to tell whether your PET is one of these models other than by trying the POKE's mentioned and switching off *immediately* if the screen display collapses. To be safe we advise readers *not* to use this method of speeding up the display.

vision 80
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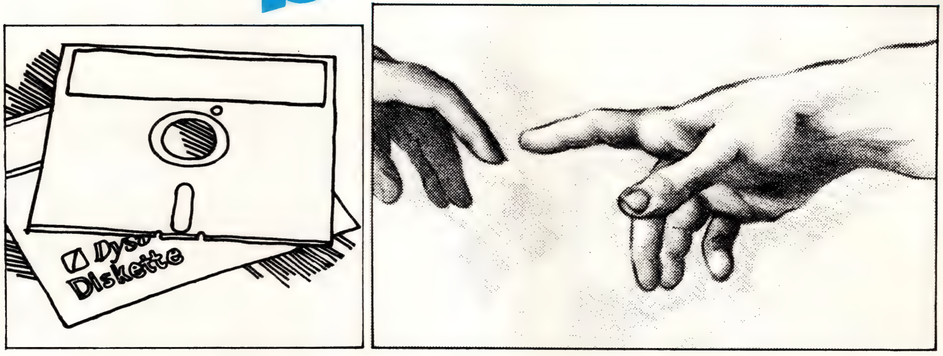

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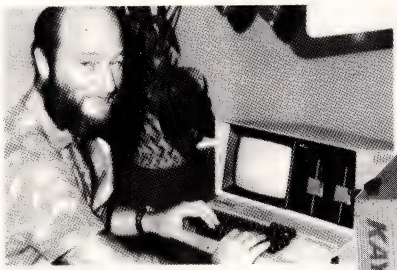

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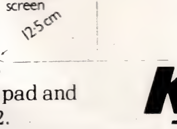

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BENCHTEST
PERSONAL COMPUTER

Panasonic JB3000

by Steve Withers

Fashions come and go in most industries: huge tail fins on cars, hi-fi systems that looked like a NASA console – microcomputing is no exception. The current trends seem to be 8088 processors, MS-DOS, graphics and large slimline keyboards. The IBM Personal Computer and the Sirius led this new wave, now joined by the Panasonic JB-3000.

Hardware

The computer itself is neatly packaged in a metal case just 9cm high. The cabinet is painted off-white and has a charcoal fascia with a green stripe. Other units in the system match in style and colour and could blend into most surroundings.

Inside the cabinet is the main logic board and the power supply. Although the circuit board almost fills the base, it is no less densely populated than most computer boards. I was disappointed to see that only the ROMs were socketed, the other chips being soldered directly to the board. Up to 64k of ROM can be installed, but only 16k is fitted to the version sold here, containing the bootstrap, I/O subroutines and the character set. 128k of RAM is also carried on the main board with provision for a piggyback pcb holding a similar amount. All RAMs are 64k by 1 bit dynamic devices (4164).

Interfaces are provided for monochrome and colour monitors and a light pen (using DIN connection on the back panel) as well as a Centronics style printer. The panel also carries the reset button and volume control (for the built-in sound generator), while the power switch is on the front of the case. Other interfaces may be filled by installing an internal mini-motherboard with connectors for 3 such cards.

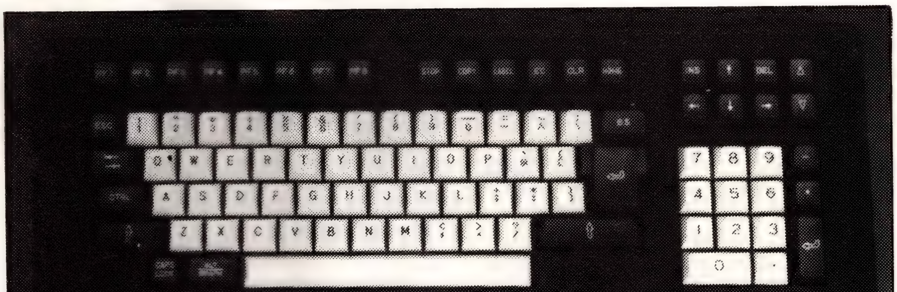
The test system was fitted with an RS-232 interface and a 5¼ inch disk controller with two drives. Both boards add a connector to the back panel, but surprisingly a DB25 socket is not used on the RS-232 board. Instead a short ribbon cable plugs into the board with the DB25 socket on the free end.

Turning to the disks, the drives themselves run smoothly and quietly, and I found the use of a small lever in place of the conventional drive door was a distinct improvement. The controller can handle up to four drives, although the third and fourth must have their own power supplies. Literature supplied with the system shows single and double drive units, but as far as I am aware only single drives are presently available.

For extra storage capacity, eight inch disks can be used giving 1Mb per drive. Once again the limit is 4 drives, but they are only sold in pairs. Standard and mini disks cannot be mixed in a system.

When other boards are released further expansion will be possible by the addition of an expansion unit providing a further six slots and room for further memory cards.

As I mentioned in the introduction, the keyboard is very slim. There is an unusual extension to the front which improves its stability when used on the lap (a reasonably long coiled cable connects the keyboard to the logic unit). All the usual keys are present, including a number pad and cursor controls. Eight shiftable programmable function keys are positioned at the top left of the board surrounded by a recess which I imagine is meant to hold an overlay showing the assigned functions, but no such overlay cards are provided. There are also four dedicated function keys: COPY (echos CRT output to the printer), STOP (cancels the effect of



The JB-3000 keyboard.

COPY), and LABEL and EC, neither of which appear to have a useful function. Keys to scroll up and down are provided, but they have no effect. Since all twelve function keys have different effects when shifted, the aide-memoir at the back of the instruction manual is very handy.

The video display can be used in a variety of modes. For text, 20 or 25 lines of 36, 40 or 80 characters may be displayed. In 36 and 40 column modes the foreground and background colours are individually controllable. To use graphics, 25 lines of text must be selected, but resolutions of 320 x 200, 640 x 200 and 640 x 400 are possible (the highest resolution should only be used with a high resolution CRT or an unpleasant flicker will occur). Low resolution graphics are in colour, but the others are black and white only. The quality of the colour display was excellent – clear, sharp, steady – absolutely beautiful. The only snag was that nominally red characters appeared in green, and vice versa. I suspect the video lead was incorrectly wired.

If a Panasonic printer is used, both text and graphics displays may be hard-copied by typing shift-COPY. Each pixel is considered to be on (printed black) or off (printed white), so a red line on a white background comes out as a solid black rectangle. An attempt at shading would be more useful but that's not as simple as it sounds. More importantly, I could not discover how to access the screen dump routine from software.

The manual warns that the 3000 may cause television interference, and it does. Fortunately, it is only mild, but it is unnecessary.

Software

The operating system supplied with the Panasonic is MS-DOS (described by Peter Rodwell elsewhere in this issue). One thing I did like was that I/O devices like the printer and console are treated as files. The system detects PRN, LST and CON as filenames even if they are dressed up (e.g. B:PRN.TXT) and sends output to the appropriate device instead of writing to a disk file. This can also be used to divert printer output to a disk file.

Other features are less exciting. The ability to edit the last command entered is useful (e.g. to correct spelling mistakes), but the scheme used seems excessively complicated.

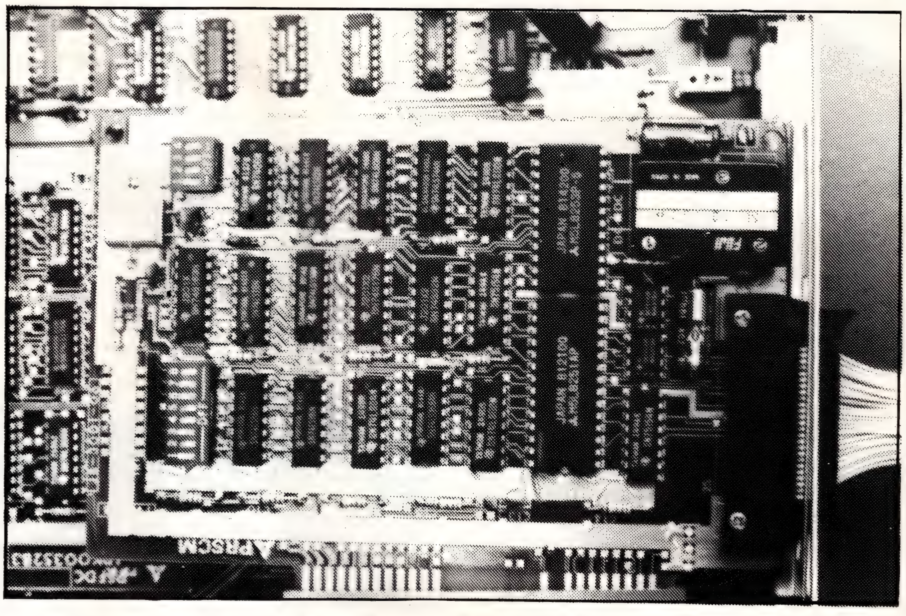
Microsoft recently announced MS-DOS version 2 (see Printout, *APC* September 1982), so it seems reasonable to expect this to appear on the Panasonic in due course.

Not one, but two Basic interpreters come with the 3000. Basic-86 is the sixteen-bit implementation of Microsoft's version 5 Basic. The other interpreter is Basic-A (Advanced Basic) with many interesting extensions. A surprising fact is that although Basic-86 is a subset of Basic-A, programs saved by one cannot be correctly loaded by the other unless saved as a text file.

When I reviewed the Tandy Color Computer I was impressed by the graphics and sound commands. I also praised the way the Hitachi Peach's Basic handled hardware features like the function keys and lightpen (ref *APC* Benchtest Special). Well, Basic-A combines the features of both and adds

TABLE 1 – BASIC-A KEYWORDS

BEEP	Generates a beep.
BLOAD	Loads a memory-image file.
BSAVE	Saves a memory-image file.
CIRCLE	Draws circles and ellipses.
CLS	Clears current active screen page.
COLOR	Sets foreground and background colours.
COM ON/OFF/STOP	Enables, disables, and buffers interrupts from communications port.
CSRUN	Returns the current row position of the cursor.
DATE, DATE$	Sets or returns current date.
DEF SEG	Sets current memory segment.
DRAW	Interprets a string of turtle-like graphics commands.
GET	Specifies length of communications file records *or* copies information from display into an array.
KEY	Assigns a string to a function key.
KEY LIST	Lists current key assignments.
KEY ON	Displays current key assignments on 25 line of screen.
KEY OFF	Cancels KEY ON.
KEY n ON/OFF/STOP	As COM ON/OFF/STOP, but for specified function key.
LINE	Draws line, box or rectangle.
LOCATE	Positions cursor on screen, changes appearance of cursor.
ON COM/KEY/PEN/STRIG	Specifies subroutine to handle interrupts for communications ports, function keys, light pen or joystick triggers.
OPEN	Extended to allow setting of RS232 parameters
PAINT	Colours a shape drawn on graphics display.
PEN ON/OFF/STOP	As COM ON/OFF/STOP, but for lightpen.
PEN (n)	Returns light pen co-ordinates.
PLAY	Interprets a string of music commands.
POINT	Returns attributes of specified pixel.
PSET	Turns pixel on.
PRESET	Turns pixel off.
PUT	As GET for communications files *or* copies an array onto the screen.
SCREEN	Specifies number of characters per line, lines per page and graphics resolution *or* returns attributes of specified character position.
SOUND	Generates a tone of specified pitch and duration.
STICK	Returns joystick co-ordinates.
STRIG ON/OFF/STOP	As COM ON/OFF/STOP but for joystick triggers.
STRIG	Returns state of joystick triggers.
TIME, TIME$	Sets or returns current time.



Multi-lingual '3000: Chips pictured here come from Japan, Taiwan, Malaysia, Singapore, Portugal and El Salvador.

more. Table 1 shows the commands and functions that Basic-A adds to Basic-86's vocabulary.

Everything seemed to work as documented (although I had neither lightpen nor joysticks), except for a rather strange bug. If either the extended version of the RUN command (e.g. RUN "PROG") or CHAIN is used to load and run a program the first PRINT statement is not executed. If PRINT USING replaces PRINT, the problem persists. A subsequent RUN works correctly, as does LOAD followed by RUN. The really puzzling thing is that the bug does not affect programs saved as ASCII files.

Program entry is speeded by the assignment of keywords to the function keys e.g. Shift-PF 4 gives CHR$(, and holding down the ALT key allows single key entry of other keywords (e.g. ALT-R generates RETURN). This can be learned quickly, as the first letter of the word is used as the abbreviation. Another labour-saving feature is the screen editor. The four cursor keys along with INSERT and DELETE are much more convenient than Basic-86's EDIT command.

Benchmark timings relate to Basic-A, and are similar to those given by eight-bit systems. The disk tests used 128 byte records (the maximum under Basic-A) and *not* the usual 256 bytes. Please take this into account when making comparisons.

Users of eight bit machines may like to know that Basic-86 gives 62281 bytes free and Basic-A, 61077.

Since the 3000 uses MS-DOS, Microsoft's Fortran and Pascal compilers can be expected shortly. No applications software was supplied with the review system but Masterplan (Microsoft's spreadsheet program) and Attache (an Australian modular accounting system) are available. The Computer Company will be stocking all Microsoft and MicroPro products as they are released for MS-DOS.

Documentation

Three different types of manual were supplied with the system. The Operating Instructions book covers setting up the system and introduces MS-DOS and Basic-A. The grammar and style aren't too bad but could use a little polishing. My main objection is the statement on the front cover "Before operating this set, please read these instructions completely" – the book is about 120 pages long! Only one third is essential reading, the rest would be better left until the computer is running. Having said that, the manual is easy to understand, contains clear illustrations and plenty of examples when describing the software.

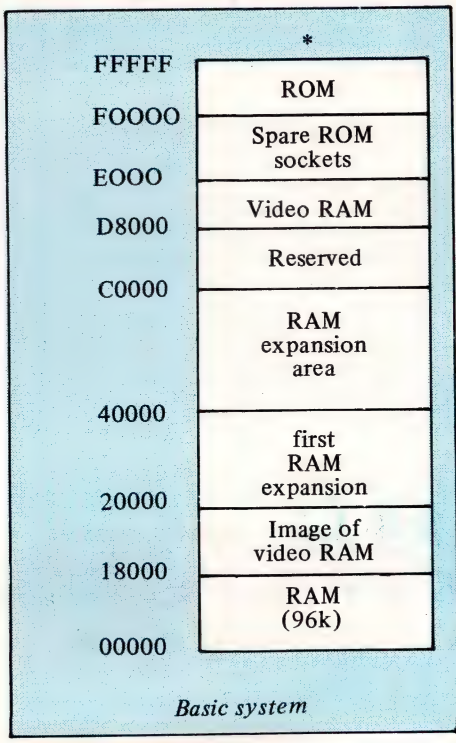
Detailed manuals for Basic and MS-DOS are provided of course, as are the standard Microsoft publications, conveniently ringbound. Finally, there is a technical reference manual with 'TENTATIVE' stamped in red on each page. This goes into considerable detail but would only be of real interest to those designing hardware accessories or writing programs which must directly access hardware registers or BIOS routines. On a cosmetic level it would be nice if all the manuals came in matching binders.

Expansion

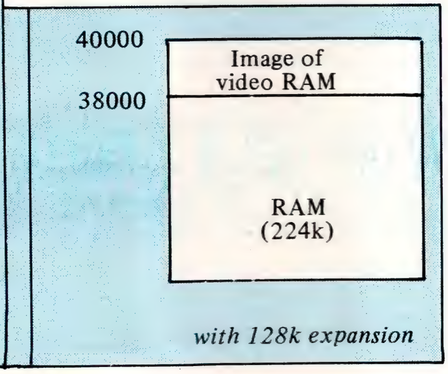
This has really been covered in the hardware section. The light pen, joysticks and expansion unit will be imported by The Computer Company in due course, and Panasonic say that an IEEE-488 interface is "to be announced". At present, a fully

Goto to page 98.

Memory map



Basic system



with 128k expansion

Benchmarks

(all times in seconds)

BM 1	1	DT 1	2
BM 2	6	DT 2	12
BM 3	13	DT 3	14
BM 4	13	DT 4	9
BM 5	26	DT 5	9
BM 6	27	DT 5	9
BM 7	41		
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AP 31

APC SUBSET

by Ian Davies

Here are more useful assembly language subroutines to add to the library of general purpose routines we are collecting. You can contribute a Datasheet, improve or develop one already printed or translate the implementation of a good idea from one processor to another.

Delay

Carrying on in the fine tradition of last month, here is a delay routine for Z80 based machines.

There are two factors controlling the total delay time. The first is the constant assembled as FRAC, and determines the basic units of delay. The second factor is input through A, and selects the number of basic delay units. For example, to produce delays which are multiples of 1/50th of a second running on a system with a 2 Mhz clock, simply set FRAC to 40,000 (since 2 million divided by 50 equals 40,000). You can then call UDRZ specifying how many fiftieths of a second you want to delay. For example, to delay for one full second, call the routine with register A containing the value 50.

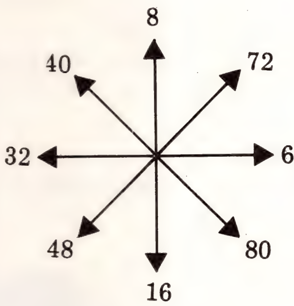
Datasheet

```
;=UDRZ - Universal Delay Routine Z80
;/CLASS: 1
;/TIME CRITICAL?: Yes
;/DESCRIPTION: Accurate delay of 1-256 times
;/             assembled fraction of system clock Hz
;/ACTION: BC <— routine operating time (inc CALL)
;/        ·Then repeat until A=zero:
;/          HL <— system clock Hz/denominator
;/          HL <— HL-BC
;/          Then repeat until HL<zero:
;/            HL <— HL-33
;/          Then repeat 33 times to use remaining
;/           T-states:
;/            L <— L+1
;/            If L=0 then L <— L-1
;/          BC <— loop operating time
;/SUBr DEPENDENCE: None
;/INTERFACES: None
;/INPUT: A=numerator (00H = 256)
;/OUTPUT: Delay of a/Denominator seconds
;/        A = 0
;/REGs USED: AF
;/STACK USE: 4
;/LENGTH: 30
;/TIME STATES: FRAC*A (inc CALL UDRZ)
;/PROCESSOR: Z80
;
FRAC:   EQU   System clock Hz/Denominator (1223 <= FRAC
;              <= 65536)
UDRZ:   PUSH  BC       ;                            C5
        PUSH  HL       ;                            E5
        LD    BC,FB39H ; Routine T states negated   01 39 FB
NUMLP:  LD    HL,FRAC  ; Clock Hz/Denominator       21 XX XX
DIVLP:  ADD   HL,BC    ;                            09
        LD    BC,FFDFH ; DIVLP T-states negated     01 DF FF
        JR    C,DIVLP  ; Div by subtraction til <0  38 FA
REMLP:  INC   L        ; Use remainder < 33 t-states2C
        JR    NZ,REMCNT ;  by using 13 instead of 12 20 01
        DEC   HL       ; T-states for REMLP exit    2B
REMCNT: INC   C        ;                            0C
        JR    NZ,REMLP ;                            20 F9
        LD    BC,FB83H ; Loop T-states negated      01 83 FB
        DEC   A        ;                            3D
        JR    NZ,NUMLP ; Repeat until A=0           20 EA
        POP   HL       ;                            E1
        POP   BC       ;                            C1
        RET            ;                            C9
```

Moving shapes

Richard Ryder gives us a routine to move shapes around a memory-mapped screen. The routine, MOOV, moves a shape consisting of adjacent characters on a single row.

The direction of movement is related to the decimal value in the A register as follows:



This gives a binary representation of the right, left, down and up movements of:

bit 76543210
64 01000000 bit 6 set; move right
32 00100000 bit 5 set; move left
16 00010000 bit 4 set; move down
8 00001000 bit 3 set; move up

The routine has to cater only for these four basic movements because the other possible values of A each set two bits, which cause the desired movement as follows:

bit 76543210
80 01010000 bits 6 & 4 set; move right and down
72 01001000 bits 6 & 3 set; move right and up
48 00110000 bits 5 & 4 set; move left and down
40 00101000 bits 5 & 3 set; move left and up

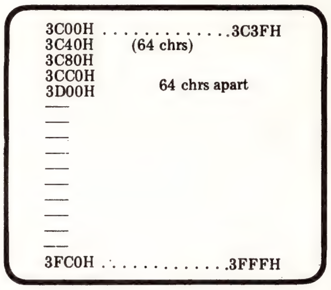


Fig 1 System 80

Richard wrote MOOV for the System 80. It should be clear from the documentation (write in with suggestions if it is not) how to adapt the routine for other memory-mapped Z80 microcomputers. But to give further help in following MOOV to those with other equipment, figure 1 shows the screen memory addresses for the System 80.

Datasheet

```
;=MOOV - Move shape on memory-mapped screen
;/CLASS: 2 Not relocatable, doesn't save all regs
;/       it could
;/TIME CRITICAL?: No
;/DESCRIPTION: Moves shape of contiguous characters on
;/             the same row, one space left, right, down,
```

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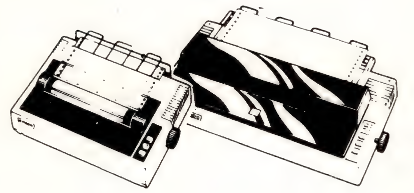

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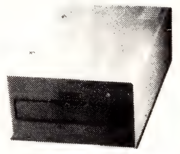

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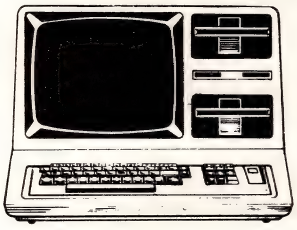

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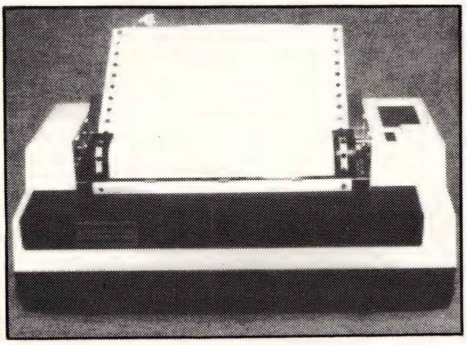

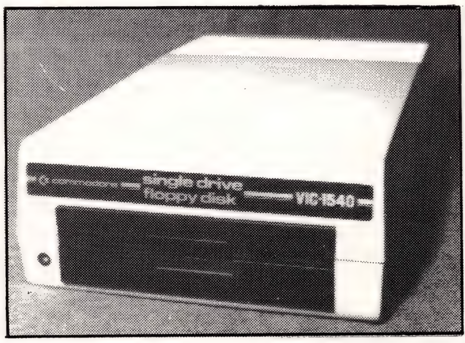

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```
;/             up or diagonally
;/ACTION: If A=64 move 1 space right
;/        If A=32 move 1 space left
;/        If A=16 move 1 space down
;/        If A= 8 move 1 space up
;/        If A=80 move 1 space right & 1 space down
;/        If A=72 move 1 space right & 1 space up
;/        If A=48 move 1 space left & 1 space down
;/        If A=40 move 1 space left & 1 space up
;/SUBr DEPENDENCE: Local in this presentation. LEFT,
;/                 UP,DOWN, RIGHT & DOMV could be filed
;/                 as separate routines
```

```
;/INTERFACES:  System 80 memory-mapped screen needed for
;/             the code given.  Alternate code is given in
;/             comments for Nascom 1.  The routines LEFT
;/             through DOMV must be located contiguously
;/             if all jumps on the displacement are to work
;/INPUT: A = decimal number 64, 32, 16, 8, 80, 72, 48 or 40
;/       HL points to lowest addressed byte of shape to be
;/       moved, low order byte 1st, high order byte next
;/OUTPUT: HL points to shape after it has been moved, lo
;/        byte 1st, hi byte next
;/REGs USED: A, HL, DE
;/STACK USE: 8
;/LENGTH: 126
;/PROCESSOR: Z80
;
MOOV:   LD    E,L       ; Get screen pos'n             5D
        LD    D,H       ;  also into DE                54
        PUSH  AF        ; Save key value               F5
        BIT   6,A       ; Test move right bit 6        CB 77
        JR    Z,NXT1    ; Jump if not set              28 05
        CALL  RIGHT     ;  else move right             CD YY YY
        LD    L,E       ; New pos'n from DE to         6B
        LD    H,D       ;  HL for next routine         62
NXT1:   POP   AF        ; Get back key value &         F1
        PUSH  AF        ;  save it again               F5
        BIT   5,A       ; Test move left bit 5         CB 6F
        JR    Z,NXT2    ; Jump if not set              28 05
        CALL  LEFT      ;  else move left              CD YY YY
        LD    L,E       ; New pos'n from DE to         6B
        LD    H,D       ;  HL for rest of routine      62
NXT2:   POP   AF        ; Get back key value &         F1
        PUSH  AF        ;  save it again               F5
        BIT   4,A       ; Test move down bit 4         CB 67
        JR    Z,NXT3    ; Jump if not set              28 05
        CALL  DOWN      ;  else move down              CD YY YY
        LD    L,E       ; New pos'n from DE to         6B
        LD    H,D       ; HL for rest of routine       62
NXT3:   POP   AF        ; Get back key value           F1
        PUSH  AF        ;  and save it again           F5
        BIT   3,A       ; Test move up bit 3           CB 5F
        JR    Z,NXT4    ; Jump if not set              38 03
        CALL  UP        ;  else move up                CD YY YY
NXT4:   POP   AF        ; Clear stack                  F1
        LD    L,E       ; Get back latest screen       6B
        LD    H,D       ;  address in HL               62
        RET             ;                              C9
;
LHE:    EQU   3FH       ;
                        ;  Least sig bits of LH char address
                        ;  minus 1
TPE:    EQU   3BH       ;
                        ;  Must = most sig byte of bottom right
                        ;  screen address minus 0040H when (AND
                        ;  ONLY WHEN) off top of screen
```

```
DNE:    EQU   3FH       ;
                        ;  Must be one less than most sig byte
                        ; of bottom right screen addr plus 0040H
                        ; when (AND ONLY WHEN)off bottom of screen
RHE:    EQU   3CH       ;
                        ;  Least sig 6 bits of RH char addr minus
                        ;  SIZ+1
SIZ:    EQU   04H       ; No of characters in shape

LEFT:   DEC   HL        ; Screen pos'n = screen        2B
                        ;  pos'n - 1
        LD    A,L       ; Will this be                 7D
        AND   3FH       ;  off the edge                E6 3F
        CP    LHE       ;  of the screen?              FE 3F
        JR    NZ,DW3    ; No - then OK                 20 1A
        INC   HL        ; Yes - so get back orig       23
                        ;  position
        JR    DW3       ; Continue                     18 17
UP:     LD    BC,FFC0H  ; BC=-40H                      01 C0 FF
        LD    A,TPE     ; A contains test for top      3E 3B
                        ;  of screen
        JR    DW1       ;                              18 05
DOWN:   LD    BC,0040H  ; BC=+40H                      01 40 00
        LD    A,DNE     ; A holds test for bottom      3E 3F
                        ;  of screen
DW1:    ADD   HL,BC     ; HL=new position              09
        CP    H         ; Test for off screen          BC
        INC   B         ; Test for adjust              04
        DEC   B         ;  to                          05
        JR    NZ,DW2    ;  carry flag                  20´01
        CCF             ;                              3F
DW2:    JR    C,DW3     ; Carry? Yes, so OK            30 02
        SBC   HL,BC     ; No so get back orig pos'n    ED 42
DW3:    PUSH  HL        ; Save new pos'n               E5
        EX    DE,HL     ; New pos'n into HL            EB
        LD    BC,1      ; Seed BC for drawing routine  01 01 00
        JR    DOMV      ; Move shape                   18 15
RIGHT:  DEC   DE        ; Is shape                     1B
        LD    A,L       ;  already at                  7D
        AND   3CH       ;  right edge? (AND 3FH for    E6 3C/3F
                        ;  Nascom)
        CP    RHE       ;  of screen?                  FE 3C
        JR    NZ,RGT1   ; No then OK                   20 01
        DEC   HL        ; Yes so adjust HL             2B
RGT1:   INC   HL        ; Save new                     23
        PUSH  HL        ;  position                    E5
        DEC   HL        ;                              2B
        LD    BC,4      ; Adjust both HL & DE          01 04 00
        ADD   HL,BC     ;  for drawing routine         09
        EX    DE,HL     ;  since must work             EB
        ADD   HL,BC     ;  backwards this time         09
        LD    BC,FFFFH  ; Seed BC =-1 for drawing      01 FF FF
DOMV:   LD    A,SIZ     ; No of chars in A             3E 04
DMV1:   PUSH  AF        ;                              F5
        LD    A,(HL)    ; Get old char                 7E
        LD    (HL),20H  ; Wipe it out of old loc       36 20
        LD    (DE),A    ; Put it in new loc            12
        ADD   HL,BC     ; Point HL & DE to             09
        EX    DE,HL     ;  next char in shape          EB
        ADD   HL,BC     ;  ie, BC=+1 or -1             09
        EX    DE,HL     ;                              EB
        POP   AF        ;                              F1
        DEC   A         ; Finished?                    3D
        JR    NZ,DMV1   ; No then continue             20 F3
        POP   DE        ; Yes so get new pos'n in DE   D1
        RET             ;                              C9
```

Our last item this month is not a Datasheet but an idea, from Richard Ryder. Although described for the System 80/TRS-80, with characters made up from the standard 2 x 3 pixels, the idea can be implemented on any machine, with whole character positions in place of pixels, if necessary.

This is how Richard describes the idea and implements it for the System 80 in Z80 code; suppose one wants to display a space-ship with a revolving centre. The sequence of events to do this can be split up into six steps as in figure 1.

The example shown is for a ship four characters long, but this could be reduced or extended to personal choice – the principle remains the same (eg, to produce an image with flapping wings simply change the first and last characters to produce a 'flapping' appearance).

```
DRALIEN:   LD     HL,nnnn      ; Load counter addr in HL
           PUSH   HL           ; Save it
           LD     A,(HL)       ; Get counter into A
           INC    HL           ; Point HL to screen pos'n addr
           LD     E,(HL)       ; Get screen pos'n
           INC    HL           ;  into
           LD     D,(HL)       ;  DE
           EX     DE,HL        ; Put screen pos'n into HL
           OR     A            ; Is count = 0?
           JR     Z,N1
           LD     (HL),+166    ; No, then print graphics 166
           JR     N2
N1:        LD     (HL),+174    ; Yes, then print graphics 174
N2:        INC    HL           ; Incr screen pos'n
           OR     A            ; Is count = 0?
           JR     Z,N3
           CP     3            ; Or is count >=3?
           JR     C,N4
N3:        LD     (HL),+179    ; Yes, then print graphics 179
           JR     N5
N4:        LD     B,1
           CALL   IN1          ; No, then print graphics 187
                               ;  or 183
N5:        INC    HL           ; Next screen pos'n
           CP     3            ; Is count >=3?
           JR     C,N6
           CP     5            ; Or is count = 5?
           JR     NZ,N7
N6:        LD     (HL),+179    ; Yes, then print graphics 179
N7:        LD     B,3
           CALL   IN1            No then print graphics 187
                                  or 183
```

Listing 1

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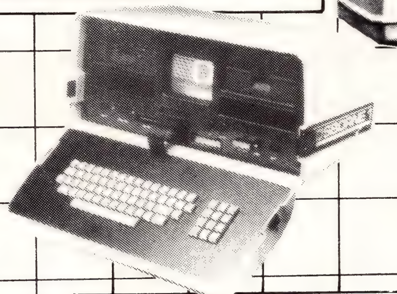

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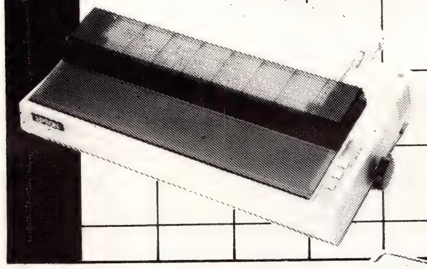

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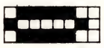
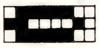
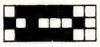
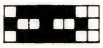
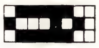
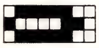
If a counter is used ranging from 0 - 5 (for the example shown), then by printing the six combinations in quick succession, the ship will appear to revolve. Once the count reaches 5, simply reset to 0 and repeat the sequence. Using this technique, some quite interesting results are obtained.

The appropriate routine to produce the revolving space-ship described is shown in listing 1. Initially, HL is loaded with the address of a byte containing the count, with the next two bytes containing the position on the screen to display the ship.

```
N8:         INC     HL                  Next screen pos'n
            LD      (HL),+132           Print graphics 132
            INC     A                   Incr pointer
            CP      6                   Is count >5?
            JR      C,N9
            XOR     A                   Yes so reset count to 0
N9:         POP     HL                ; Get counter addr into HL
            LD      (HL),A            ; Save new counter
            RET
;
IN1:        SUB     B                 ; Subroutine decides
            JR      Z,IN2             ;  whether
            LD      (HL),+187         ;  to print 187
            JR      IN3
IN2:        LD      (HL),+183         ;  or 183
IN3:        ADD     A,B
            RET
```

Listing 1 (cont.)

Fig 1

counter		ASCII code (for System 80)
5		166,179,179,132
0		174,179,179,132
1		166,183,179,132
2		166,187,179,132
3		166,179,183,132
4		166,179,187,132

To produce a reasonable effect, the routine should be called from within a loop, which includes a suitable delay, eg:

```
LOOP:   CALL DRALIEN    ; draw ship.
        LD BC, + 5000
LP1:    DEC  BC         ; do delay.
        LD  A,B
        OR  C
        JR  NZ, LP1
        JR  LOOP        ; repeat.
```

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Original development took place in England, with Barry Meredith and John Perry of Padmede in Australia making extensive changes to suit local requirements. This included use of the advanced Sigma/OKI facilities such as high resolution colour display and inbuilt 80 cps printer.

Sigma/OKI Personal Computers also have a large library of software from other suppliers. These include Digital Research, Micropro, Sorcim, and Australian applications from Cyres, Boulevard, IMS, John F. Rose and others.

Kathy McLean and Barrie Meredith from Padmede

Packages ready for use under CP/M include Wordstar, Mailmerge, Supercalc, Spellstar, DBase II, FMS-80, Supersort and many many more.
Our dealers will be pleased to give personalized advice. The Sigma/OKI Dealer index can be found earlier in this issue.

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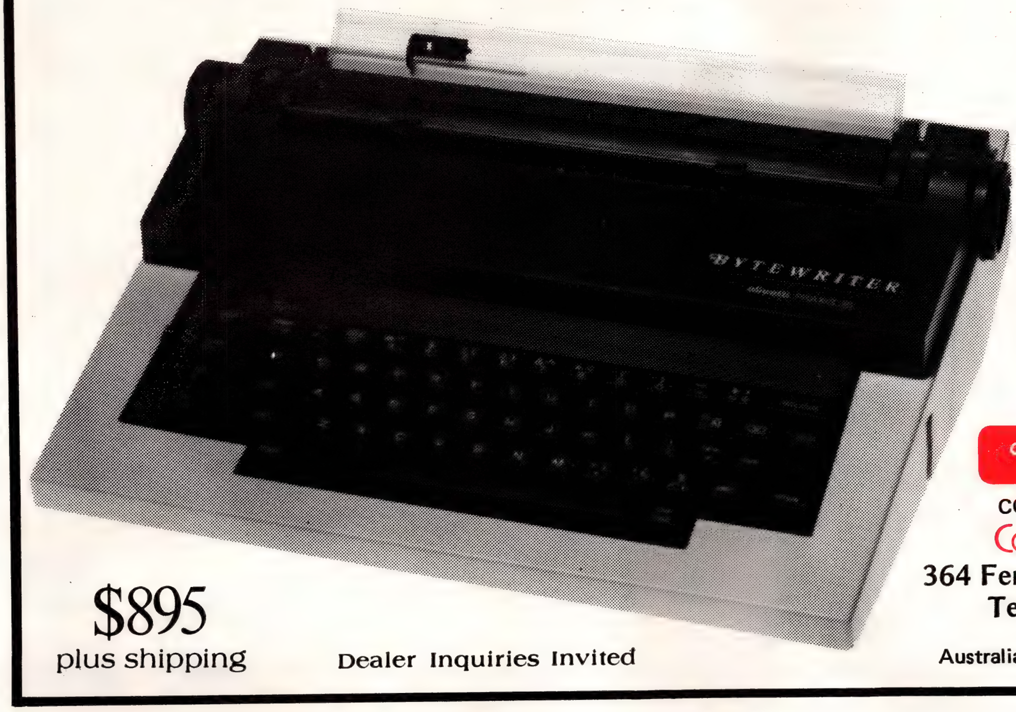

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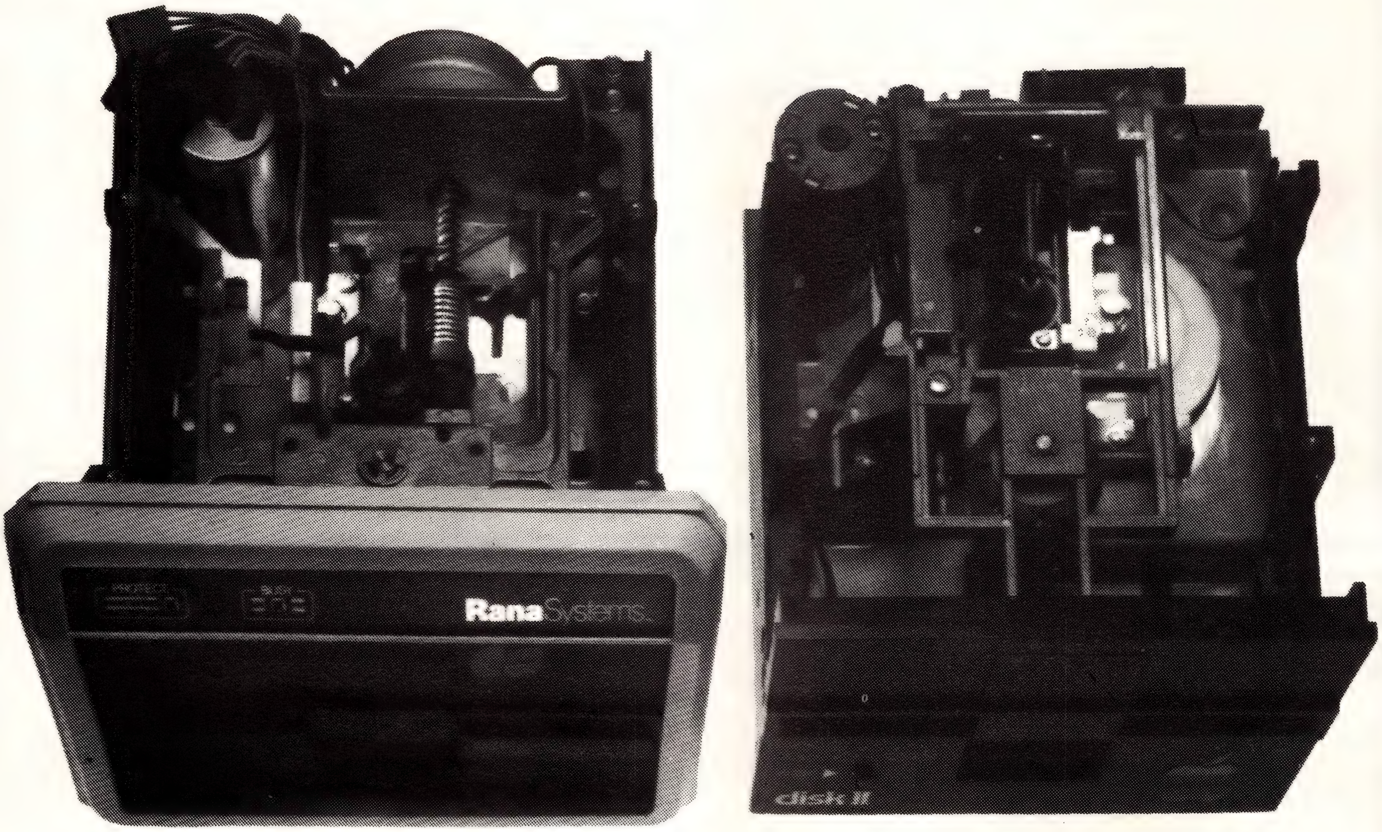

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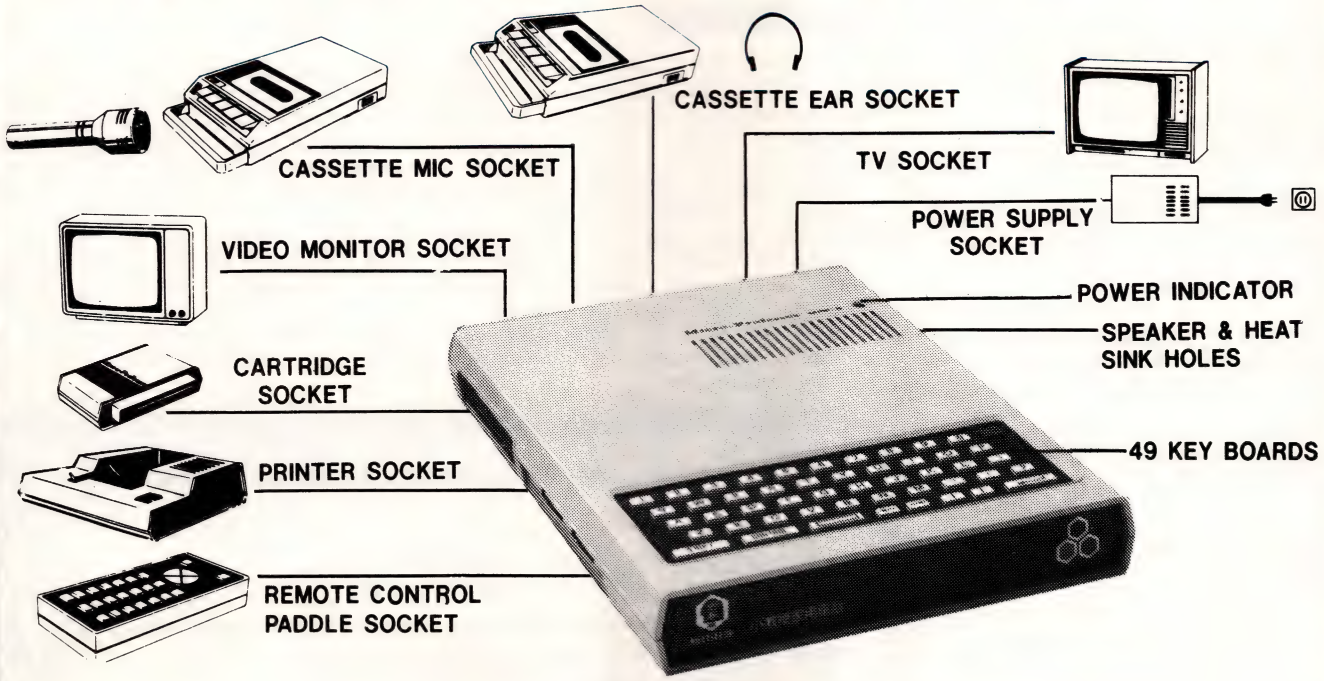

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Panasonic JB3000

Cont. from page 87.

expanded system contains 256k RAM, 4 disk drives and two RS232 ports.

Conclusions

At present there is simply not enough software for the Panasonic to suggest uses to which it will be put. For the wealthy it would make a fine home computer. With the extra capacity of 8 inch disks a useful business system could be assembled. Scientific and technical users might like the forthcoming IEEE-488 interface, but the omission of double-precision arithmetic from the MS-Fortran compiler will be a drawback. I think educational users would probably prefer to buy several cheaper computers.

If good software appears quickly enough, Panasonic are in with a chance. If the IBM PC is launched before that happens I suspect the 3000 could sink, which would be a shame as it is a nice piece of kit.

Prices

The Computer Company prefers to quote for complete systems instead of giving the prices of individual components. Examples are: 128k RAM, monochrome display, 80 column printer, two 5¼ inch disk drives, MS-DOS, Basic-86, Basic-A and Multiplan costs $5998 (all prices recommended retail, including sales tax). A similar system with 8 inch drives and a 132 column printer is $8875. The RS232 card costs $253 and the 128k RAM expansion is $533.

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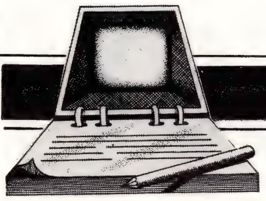
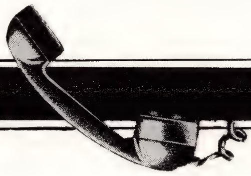


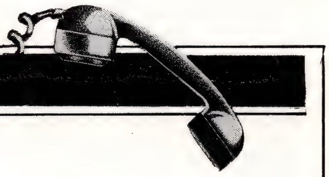
DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printer's errors, etc. Organisers are requested to notify APC of forthcoming events well in advance to allow time for inclusion in 'Diary Data'.

Brisbane	Computers Business Equipment Exhibition. Contact: US Marketing Centre, Sydney (02) 929 0977	November 29 – December 3, 1982
Sydney	The 1st Australian Personal Computer Show, Centrepoint. Contact: Australian Exhibition Services	March 10–12, 1983



NETWORK NEWS



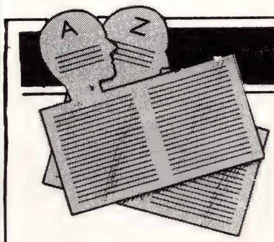
Here is a list of all Australian personal computer networks. As more networks appear – and as more facilities are added to existing ones – we'll report them in this section, which appears monthly.

The Australian Beginning. Operator: The Australian Beginning Pty. Ltd. 364 La Trobe Street, Melbourne. Tel: (03) 329 7998. Facilities: Information service, electronic mail, software storage, and software downloading. Hours: 24 hours/day, 7 days/week.

INFONET. Operator: Network Services Division of Computer Sciences of Australia Pty. Ltd., 460 Pacific Highway, St Leonards, NSW. Tel: (02) 439 0033. Facilities: Access to databases produced by the Australian Bureau of Statistics and the Institute of Economic and Social Research. Hours (E.S.T.): Monday to Friday (7am to 9pm), Saturday (8am to 5pm) and Sunday (8am to 11.30am).

AUSINET. Operator: ACI Computer Services, P.O. Box 42, Clayton, Victoria. Tel: (03) 544 8433. Facilities: Medium to databases whose subject coverage includes agriculture, education, energy, industry, public affairs, science and technology and an online Australian database directory. Hours: 8.30am to 9.00pm E.S.T. Monday to Friday.

IP Sharp Associates Network. Operator: IP Sharp Associates Pty. Ltd., 13th Floor, 175 Pitt Street, Sydney. Tel: (02) 232 6366. Facilities: The network is an international time sharing data processing network, the host computers being located in Toronto, Canada. Hours: 24 hours/day, 7 days/week.



USER GROUPS INDEX

Below is a list of alterations and additions to the list of user groups published in the August issue. The next full listing will be published in the January '83 issue of APC.

PEACH USERS GROUP

This Melbourne group meets each alternate Friday, 8pm, at the Templestowe Technical College, Cyprus Avenue, Templestowe. For more information phone Greg Hudson on (03) 429 3216.

MICROBEE USERS GROUP

Meets on the second Wednesday of each month at the Burwood Teachers College, Building E. Further information, contact Grant Forest on (03) 879 2257 or write to 10 Sunbeam Avenue, Ringwood East, 3135.

NEWCASTLE 80 MICRO USERS GROUP (NMUG)

Meetings are on the last Wednesday of each month at the hall on the corner of Fowler and Ogden Streets, Hamilton South, NSW. Contact, Dennis Jackson on (049) 68 1910.

WA ZX USERS GROUP

The group only began in September and can be contacted by phoning Phil Taylor on (09) 328 4111 (BH) or (09) 328 8111 (AH).

BLUE MOUNTAINS COMPUTER CLUB

The club now meets on the second and last Friday of each month at the Springwood Civic Centre. Meetings start at 7.30pm.

SYDNEY PEACH USER GROUP

The contact address is 261 Northumberland Street, Liverpool, 2170, or, for more information, telephone Ben Sharif on (02) 707 2466 (BH), (02) 36 4825 (AH) or Esther on (02) 601 8493 (BH).

THE ULTIMATE TEST?

by Chris Sadler and Sue Eisenbach

In the September issue of *Byte* magazine, Jim Gilbreath, head of the Computer Sciences and Simulations Department of the Naval Ocean Systems Centre in San Diego, published a benchmark program which he had translated into 10 different languages and run on dozens of different machines and compilers.

While preparing this month's article on the different language translators available under SofTech's UCSD (version IV) p-System, we decided to use his program to compare the efficiency of the p-code produced by the p-System's Pascal, Fortran 77 and Basic compilers. Frankly, since the p-System is so well-known for its Pascal, we had expected that only lip-service would have been paid to the problem of optimising the p-code statements generated by the other two compilers. The benchmark uses an algorithm based on the Sieve of Eratosthenes to compute the 1899 prime numbers between 3 and 16384.

Once a prime is found, all multiples within range are eliminated, and this information has to be remembered for subsequent processing, so quite a lot of storage is necessary. Unfortunately, SofTech's Basic did not have room in RAM for the 8k in reals (we decided not to use virtual arrays as we didn't want to compare disk and RAM accessing) required by the *Byte* program and in the end we had to reduce the array to 4k of integers before it would fit in — ie, all primes from 3 to 8181. The programs in Pascal and Fortran are set up to do 10 iterations of the algorithm (as in the original article), although the figures presented below are for a single pass in order to be comparable with the Basic program. The reason Jim Gilbreath built in the different iteration count was to get similar figures for compiled and interpreted code — but since, on the p-System, all the programs are compiled into p-code which is subsequently interpreted, the need for this distinction disappears.

Language	Compile time	8k primes	16k primes
Basic	33.6 secs	15.7 secs	—
Fortran	27.7 secs	14.1 secs	28.6 secs
Pascal	28.1 secs	13.0 secs	26.6 secs
UCSD Pascal	30.6 secs	11.0 secs	20.4 secs

Table 1

```
10 REM ERATOSTHENES SIEVE PRIME
   NUMBER PROGRAM IN BASIC
20 INTEGER ALL
30 SYZE = 4094
40 DIM FLAG(4095)
50 DISPLAY "ONLY 1 ITERATION"
60 COUNT = 0
70    FOR I = 0 TO SYZE
80      FLAG(I) =1
90    NEXT I
100   FOR I = 0 TO SYZE
110       IF FLAG(I) =0 THEN 180
120       PRIME = I+I+3
130       K = I + PRIME
140       IF K>SYZE THEN 170
150       FLAG(K) = 0
160       K = K + PRIME
170       GOTO 130
180       COUNT = COUNT + 1
185       REM DISPLAY PRIME
190    NEXT I
200 DISPLAY COUNT," PRIMES"
210 END
```

```
    Program Primer;
    { Eratosthenes Sieve Prime Number Program
    using UCSD Pascal features }

 Const size = 4094;

 Var flags : Array [0..size] of Boolean ;
     i, prime, k, count, iter : Integer ;

 Begin
     Writeln ('10 iterations') ;
     For iter := 1 to 10 Do
     Begin
         count := 0 ;
         fillchar(flags, sizeof(flags), true) ;
         For i := 0 to size Do
             If flags[i]
             Then
             Begin
                prime := i+i+3 ;
                k := i + prime ;
                While k <= size Do
                Begin
                   flags[k] := False ;
                   k := k + prime
                End ;
                count := count + 1
             End
     End ;
     Writeln (count, ' primes')
 End .
```

```
C         Eratosthenes Sieve Prime Number Program
          in FORTRAN

        LOGICAL FLAGS (8191)
        INTEGER I, PRIME, K, COUNT, ITER
        WRITE (1,50)
 50     FORMAT (' 10 Iterations')
        DO 92 ITER = 1, 10
          COUNT = 0
          DO 10 I = 0, 8190
 10       FLAGS(I) = .TRUE.
          DO 91 I = 0, 8190
            IF (FLAGS(I) .EQ. .FALSE.) GOTO 91
            PRIME = I + I + 3
            K = I + PRIME
  20        IF (K .GT. 8190) GOTO 90
            FLAGS(K) = .FALSE.
            K = K + PRIME
            GOTO 20
  90        COUNT = COUNT + 1
 C          WRITE(1, 100) COUNT
  91      CONTINUE
  92    CONTINUE
        WRITE(1, 200) COUNT
        STOP
 100    FORMAT(1X, I6)
 200    FORMAT(1X,I6,' Primes')
        END
```

```
Program Primer;
{ Eratosthenes Sieve Prime Number
Program in Pascal }


 Const size = 8190;

 Var flags : Array [0..size] of Boolean ;
     i, prime, k, count, iter : Integer ;

 Begin
     Writeln ('10 iterations') ;
     For iter := 1 to 10 Do
     Begin
         count := 0 ;
         For i := 0 to size Do flags [i] := True ;
         For i := 0 to size Do
             If flags[i]
             Then
             Begin
                prime := i+i+3 ;
                k := i + prime ;
                While k <= size Do
                Begin
                   flags[k] := False ;
                   k := k + prime
                End ;
                count := count + 1
             End
     End ;
     Writeln (count, ' primes')
```

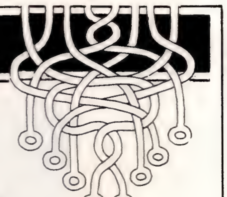
A high-level language benchmark

THE ULTIMATE TEST?

Finally, the Pascal program published in *Byte* is, in fact, a UCSD Pascal version, utilising FILLCHAR and the function SIZEOF to initialise the Boolean array. Gilbreath regarded as legitimate the use of such implementation-dependent features for his comparisons but we have produced a 'plain' Pascal program to compare with the Fortran and Basic ones. Nevertheless, it is interesting to note that the LSI-11 timing quoted in the articles (for a Terak running UCSD Version II) at 317 sec is 156 per cent slower than our system. Table 1 shows the timings of the programs. The benchmark programs are also listed.

As expected, the UCSD Pascal version runs faster but takes longer to compile (probably due to the need to reference the library more extensively). True to its reputation, the Fortran compiler is fast, but its code does not run quite so quickly as the Pascal versions.

LAZING AROUND



by J J Clessa

We received 93 entries to the August Puzzle. Quite a few got the answer wrong, although some still complained that it was too easy. There's no satisfying some folks! The answer was 97344. And the winner was B G Quinn of Wollongong. Congratulations Mr Q, your prize should have reached you by the time you read this.

Quickie

No answers, no prizes. If it takes four men eight days to dig four holes, how long does it take one man to dig half a hole? The answer is not four days.

Prize puzzle

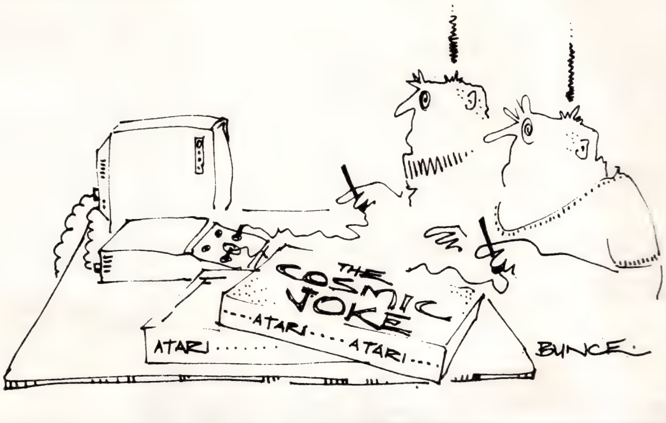
This should test your micros! A certain number, greater than 5000 but less than 50,000, when divided by four gives a remainder of three; when divided by five gives a remainder of one; when divided by seven gives a remainder of two; when divided by 11 gives a remainder of 2 and when divided by 17 gives a remainder of 12. What is that number?

Answers, on postcards only, please to: October Prize Puzzle, P.O. Box 280, Hawthorn, Vic 3122 to arrive not later than 30 November 1982.

BLUDNERS

Readers will remember the article 'Pouring Schooners into Midies' which we published in June *APC*. We have to admit that we made rather a dog's dinner of it and, in fact, the author's name did not appear beneath the title (or anywhere else on the page!) and so we'll apologise here instead to Erwin Schneider for this mistake.

There were also three little slip-ups in the text and these are as follows: At the end of paragraph four the number 195,000 should read 105,000; in the fourth paragraph from the end, the text refers to 'altering the value of 1'– the '1' should be 'I' and finally in the program listing (line 330) the first character before the '=' should be a 'k'.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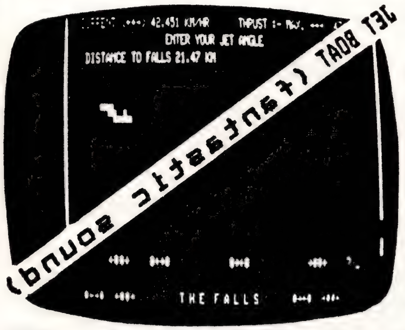

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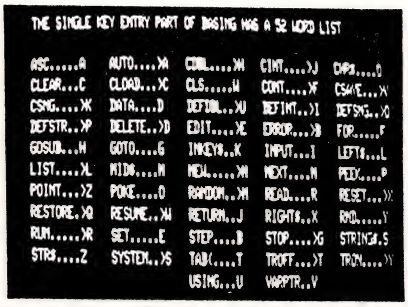

```
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CSNG....XK  DATA....D   DEFDBL..XU  DEFINT..)I  DEFSNG..XO
DEFSTR..XP  DELETE..)D  EDIT....XE  ERROR...XB  FOR.....F
GOSUB...H   GOTO....G   INKEY$..K   INPUT...I   LEFT$...L
LIST....XL  MID$....M   NEW.....XM  NEXT....N   PEEK....P
POINT...)Z  POKE....O   RANDOM..XM  READ....R   RESET...)X
RESTORE.XQ  RESUME..XW  RETURN..J   RIGHT$..X   RND.....Y
RUN.....XR  SET.....E   STEP....B   STOP....XG  STRING$.S
STR$....Z   SYSTEM..XS  TAB(....T   TROFF...)T  TRON....)Y
                        USING...U   VARPTR..V
```

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NEWCOMERS START HERE

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in APC. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say 'numbering system with a radix of 16 in which the letters A to F represent the values ten to 15' when instead we can simply say 'hex'. No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, APC will be publishing this guide — every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, **processing** it, storing the results or sending them somewhere else. All this information is called **data** and it comprises numbers, letters and special symbols which can be read by humans. Although the data is accepted and output by the computer in 'human' form, inside it's a different story — it must be held in the form of an electronic code. This code is called **binary** — a system of numbering which uses only 0s and 1s. Thus in most micros each character, number or symbol is represented by eight binary digits or **bits** as they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being **ASCII** (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 00110101 — complicated for humans, but easy for the computer! This collection of eight bits is called a **byte** and computer freaks who spend a lot of time messing around with bits and bytes use a half-way human representation called **hex.** The hex equivalent of a byte is obtained by giving each half a single character code (0—9, A—F): 0 = 0000, 1 = 0001, 2 = 0010, 3 = 0011, 4 = 0100, 5 = 0101 . . . . E = 1110 and F = 1111. Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of 0s and 1s. The machine detects these 0s and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by comparing it with other data. It's the latter function that gives a computer its apparent 'intelligence' — the ability to make decisions and to act upon them. It has to be given a set of rules in order to do this and, once again, these rules are stored in **memory** as bytes. The rules are called **programs** and while they can be input in binary or hex (**machine code** programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably; the nearer the **programming language** is to English, the faster the programming time. On the other hand, program execution speed tends to be slower.

The most common microcomputer language is **Basic**. Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To **run** such a program the computer uses an **interpreter** which picks up each English-type **instruction**, translates it into machine code and then feeds it into the **processor** for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with Basic are **PEEK** and **POKE**. They give the programmer access to the memory of the machine. It's possible to read (PEEK) the contents of a byte in the computer and to modify a byte (POKE).

Moving on to **hardware**, this means the physical components of a computer system as opposed to **software** — the programs needed to make the system work.

At the heart of a microcomputer system is the central processing unit (**CPU**), a single microprocessor chip with supporting devices such as **buffers**, which 'amplify' the CPU's signals for use by other components in the system. The packaged chips are either soldered directly to a printed circuit board (**PCB**) or are mounted in sockets.

In some microcomputers, the entire system is mounted on a single, large, PCB; in others a **bus system** is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these are several smaller PCBs, each with a specific function — for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the **S100**.

The CPU needs memory in which to keep programs and data. Microcomputers generally have two types of memory, **RAM** (Random Access Memory) and **ROM** (Read Only Memory). The CPU can read information stored in RAM — and also put information into RAM. Two types of RAM exist — **static** and **dynamic**; all you really need know is that dynamic RAM uses less power and is less expensive than static, but it requires additional, complex, circuitry to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers often store interpreters and the like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called **PROMs** (Programmable ROMs) and **EPROMs** (Eraseable PROMs) which can be programmed using a special device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, **cassettes** and **floppy disks** are used to save programs and data for later use. Audio-type tape recorders are often used by converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and play back information and it's difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, **floppy disks** are used on more sophisticated systems.

A floppy disk is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disk, in its protective envelope, is placed in a disk drive which rotates it and moves a **read/write head** across the disk's surface. The disk is divided into concentric rings called **tracks**, each of which is in turn subdivided into **sectors**. Using a program called a **disk operating system**, the computer keeps track of exactly where information is on the disk and it can get to any item of data by moving the head to the appropriate track and then waiting for the right sector to come round. Two methods are used to tell the computer where on a track each sector starts: **soft sectoring** where special signals are recorded on the surface and **hard sectoring** where holes are punched through the disk around the central hole, one per sector.

Half-way between cassettes and disks is the **stringy floppy** — a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. **Hard disk** systems are also available for micro-computers; they store more information than floppy disks, are more reliable and information can be transferred to and from them much more quickly.

You, the user, must be able to communicate with the computer and the generally accepted minimum for this is the visual display unit (**VDU**), which looks like a TV screen with a typewriter-style **keyboard**; sometimes these are built into the system, sometimes they're separate. If you want a written record (**hard copy**) of the computer's output, you'll need a **printer**.

The computer can send out and receive information in two forms — **parallel** and **serial**. Parallel input/output (**I/O**) requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, with a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as the **baud rate** and, very roughly, the baud rate divided by ten equals the number of bytes being sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces; the most common is **RS232** (or **V24**) while, for parallel interfaces to printers, the **Centronics** standard is popular.

Finally, a **modem** connects a computer, via a serial interface, to the telephone sytem allowing two computers with modems to exchange information. A modem must be wired into the telephone system and you need Telecom's permission; instead you could use an **acoustic coupler**, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system – Telecom isn't so uppity about the use of these

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TRS-80 Cardshuffler

By Russell Hutson

Here's a routine to add to your card playing programs which will act as something of a croupier. It takes up 3.93k but can be compressed to 2.95k by removing REMs and other trimmings.

It is designed to set up a pack of 52 cards, set up a copy of this pack and shuffle the deck. This process takes 14 seconds on average and an area is marked in the listing where the rest of a card game can be inserted, using the arrays set up by the routine. Output is in the form 'AS BLK 1 11' — A being rank, S suit, BLK colour and 1 11 being values (in this case either one or 11 for an ace). The program will run on its own, but it is not meant to do so. A list of variables at the end should serve as a useful guide when writing a full program using the shuffler.

It need a TRS-80 Level II or System 80 to run, but should be quite easy to convert for use on other micros.

```
0 REM////////////////////////////////////////////////////////////
1 REM/////// PACK OF CARDS SUBROUTINE-DEC1981RHUTSON ////////
2 REM////////////////////////////////////////////////////////////
10 CLS:CLEAR2048:S=1
20 DIM CL$(2),S$(4),N$(13),C$(4,13),V$(2,13),CP$(4,13),SP$(52),
   PC$(52),CC$(79)
30 PRINT" PLEASE WAIT WHILE I LOOK FOR THE PACK OF CARDS."
40 FORX=1TO2:READCL$(X):NEXT
50 FORX=1TO4:READS$(X):NEXT
60 FORX=1TO13:READN$(X):NEXT
70 FORX=1TO13:READV$(1,X):NEXT
80 FORX=1TO13:READV$(2,X):NEXT
90 PRINT"
I THOUGHT I PUT THEM IN THAT 1K NEXT TO THE CPU."
100 FORC=1TO4:FORX=1TO13
110 IFS$(S)="H"ORS$(S)="D"THENCL=1ELSECL=2
120 C$(C,X)=N$(X)+S$(S)+" "+CL$(CL)+" "+V$(1,X)+" "+V$(2,X)
130 NEXT:S=S+1:NEXT
140 PRINT"
 AH.... THERE THEY ARE! WHO PUT THEM IN THAT MEMORY LOCATION ?"
150 GOSUB170
160 PRINT"
 I'M GOING TO SHUFFLE NOW
 (I'M ALL FINGERS & RESISTORS AT THIS)":GOTO200
170 FORC=1TO4:FORX=1TO13
180 CP$(C,X)=C$(C,X):NEXT
190 RETURN
200 REM ////// SHUFFLE ROUTINE //////
210 FORX=1TO52
220 C=RND(13):S=RND(4)
230 IFC$(S,C)=""THEN220
240 SP$(X)=C$(S,C):C$(S,C)=""
250 IFC=1ANDS=3THENPRINT"
 OOPS! DROPPED THAT ONE... DIDN'T SEE IT, DID YOU?"
260 NEXT
270 PRINT"
THEY'RE SHUFFLED ENOUGH. NOW COMES THE GAME"
300 REM
310 REM
320 REM ########################################################
330 REM ############# INSERT CARD PROGRAM HERE ##############
340 REM ########################################################
350 REM
360 REM
940 END
950 DATA RED,BLK
960 DATA H,D,S,C
970 DATA A,2,3,4,5,6,7,8,9,10,J,Q,K
980 DATA 1,2,3,4,5,6,7,8,9,10,10,10,10
990 DATA 11,2,3,4,5,6,7,8,9,10,10,10,10:REMALTERNATIVE VALUES
65519 REM========= VARIABLES USED ==========
65520 CL$ - ARRAY HOLDING COLOURS (RED/BLK)
```

```
65521 S$  - ARRAY HOLDING SUIT (H/D/S/C)
65522 N$  - ARRAY HOLDING CARD NAME VALUE (ACE OF HEARTS ETC.)
65523 C$  - ARRAY HOLDING WHOLE PACK OF CARDS (C$(SUIT,VALUE))
65524 V$  -ARRAY HOLDING 2 CARD VALUES (1=NORM:2=PONTOON)
65525 CP$ - ARRAY HOLDING COPY OF PACK
65526 X/C - LOOP VARIABLES
65527 S   - SUIT
65528 CL  - COLOUR NUMBER (1=RED:2=BLACK)
```

PET Knockout

by Paul Bradshaw

This is an application program which will organise and control a knockout tournament for any number of players. The author tells me that it was written for an Egg-Jarping contest at Easter but readers will have to use their imagination on what exactly this involves, as no further explanation was offered!

Players are entered either through the keyboard or from a previous record on tape. The ability to save competitors' names on tape is useful if several tournaments are being held using the same players. A printed list of competitors can also be obtained.

When all the players' names have been entered, the computer will allocate matches at random. The user is asked to input all the results and the winner is eventually decided.

This program will run on any PET— it was developed on the 3.0 ROM. Some POKEs will have to be added to the tape file routines for 'old ROM' PETs and these are detailed in the latest manual.

Listing courtesy of Mr S Warner.

```
100 A=RND(0)
110 PRINT"⊐"TAB(16)"KNOCKOUT
120 PRINTTAB(16)"————————
130 PRINT"▮PLEASE CHOOSE YOUR OPTION:
140 PRINT"——————————————————————————
150 PRINT"▮▮1. INPUT COMPETITORS FROM KEYBOARD
160 PRINT"▮2. INPUT COMPETITORS FROM CASSETTE
170 PRINT"▮3. STORE COMPETITORS ON CASSETTE
180 PRINT"▮4. PRINT OUT LIST OF COMPETITORS
190 PRINT"▮5. CARRY OUT KNOCKOUT COMPETITION
200 PRINT"▮6. EXIT TO BASIC
210 PRINT"▮▮WHICH ONE DO YOU WANT?
220 GETH$:H=VAL(H$):IFH<1ORH>6THEN220
230 IFH=6THENPRINT"⊐";:END
240 ONHGOSUB260,390,550,660,810
250 GOTO110
260 REM *** ENTER COMPETITORS FROM KEYBOARD ***
270 CLR
280 PRINT"⊐HOW MANY COMPETITORS? ";
290 GOSUB1420:NC=A
300 IFNC<2THEN280
310 DIMC$(NC),X$(NC),Y$(NC/2+1),B$(SQR(NC)+1),F(NC)
320 PRINT"⊐";
330 FORJ=1TONC
340 PRINT"▮TYPE NAME OF COMPETITOR"J":";
350 GOSUB1420:C$(J)=A$
360 FORK=1TOJ-1:IFC$(K)<>A$THENNEXT
370 IFK<JTHENPRINT"▮SAME NAME ENTERED TWICE!":GOTO340
380 NEXTJ:GOTO110
390 REM *** INPUT COMPETITORS FROM CASSETTE ***
400 GOSUB1460
410 PRINT"▮▮TYPE FILE NAME OR * TO USE
420 PRINT"▮FIRST FILE FOUND: ";:GOSUB1420
430 IFLEN(A$)>10THENPRINT"▮MAXIMUM LENGTH
     IS 10 CHARACTERS!⌉":GOTO410
440 F$="KC:"+CHR$(1):IFA$<>"*"THENF$=F$+A$
450 PRINT:OPEN1,1,0,F$
460 PRINT"▮THE FILE HAS BEEN FOUND.
470 INPUT#1,NC:CLOSE1
480 POKE16,INT(NC/256):POKE15,NC-256*PEEK(16)
490 CLR
500 NC=PEEK(15)+256*PEEK(16)
510 DIMC$(NC),X$(NC),Y$(NC/2+1),B$(SQR(NC)+1),F(NC)
520 OPEN1
530 FORJ=1TONC:INPUT#1,C$(J):NEXT
540 CLOSE1:GOTO110
```

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```
550 REM *** STORE COMPETITORS ON CASSETTE ***
560 IFNC=0THENRETURN
570 GOSUB1460
580 PRINT"▮▮TYPE FILE NAME: ";:GOSUB1420
590 IFLEN(A$)>10THENPRINT"▮MAXIMUM LENGTH,
    IS 10 CHARACTERS!▮":GOTO580
600 F$="KC:"+CHR$(1)+A$
610 PRINT:OPEN1,1,1,F$
620 PRINT#1,NC
630 CLOSE1:OPEN1,1,1
630 CLOSE1:OPEN1,1,1
640 FORJ=1TONC:PRINT#1,C$(J):NEXT
650 CLOSE1:RETURN
660 REM *** PRINT LIST OF COMPETITORS ***
670 IFNC=0THENRETURN
680 PRINT"▮PRESS 'SPACE' TO CONTINUE AFTER EACH
690 PRINT"▮SCREENFUL OF NAMES.
700 PRINT"▮▮PRESS 'SPACE' FOR LISTING...
710 GETH$:IFH$<>" "THEN710
720 PRINT"▮";
730 FORJ=1TONC
740 PRINT"▮"J":"TAB(6)C$(J)
750 IFJ/11>INT(J/11)THEN770
760 GETH$:IFH$<>" "THEN760
770 NEXT
780 PRINT"▮▮PRESS 'SPACE' TO CONTINUE...
790 GETH$:IFH$<>" "THEN790
800 RETURN
810 REM *** CARRY OUT COMPETITION ***
820 IFNC=0THENRETURN
830 PRINT"▮WHEN THE MATCHES ARE BEING PRINTED OUT,
840 PRINT"▮PRESS 'SPACE' TO CONTINUE AFTER EACH
850 PRINT"▮SCREENFUL OF INFORMATION.
860 PRINT"▮▮WHEN ENTERING THE WINNERS OF EACH MATCH,
870 PRINT"PRESS ▮1▮ OR ▮2▮ TO INDICATE WHICH
880 PRINT"▮COMPETITOR WON.
890 PRINT"▮▮PRESS 'SPACE' TO CONTINUE...
```

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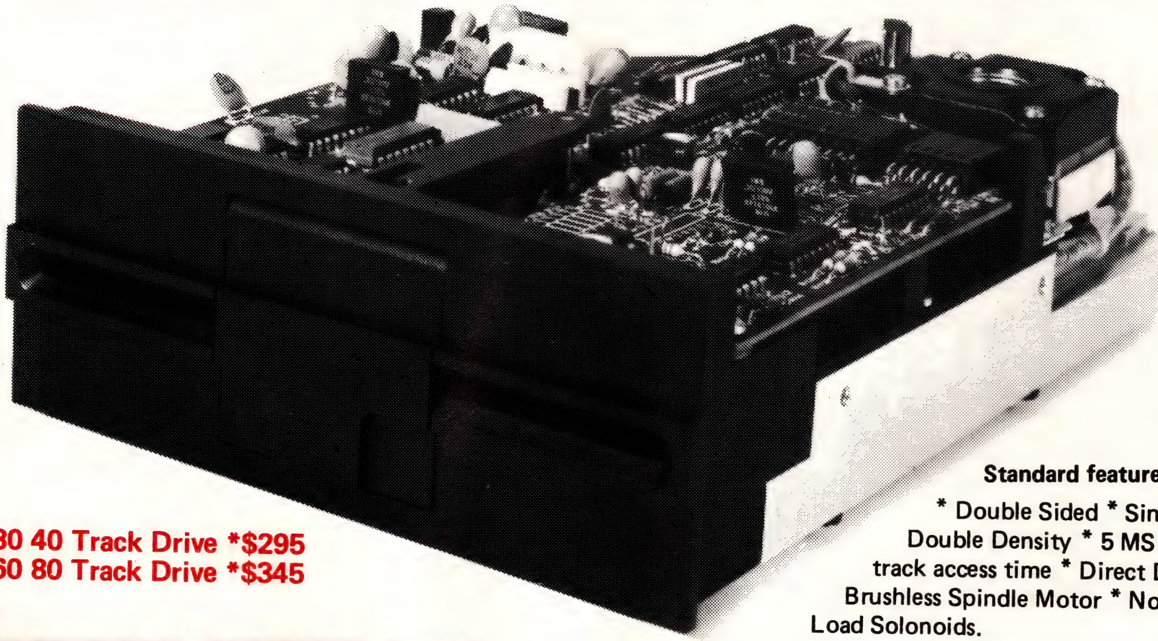

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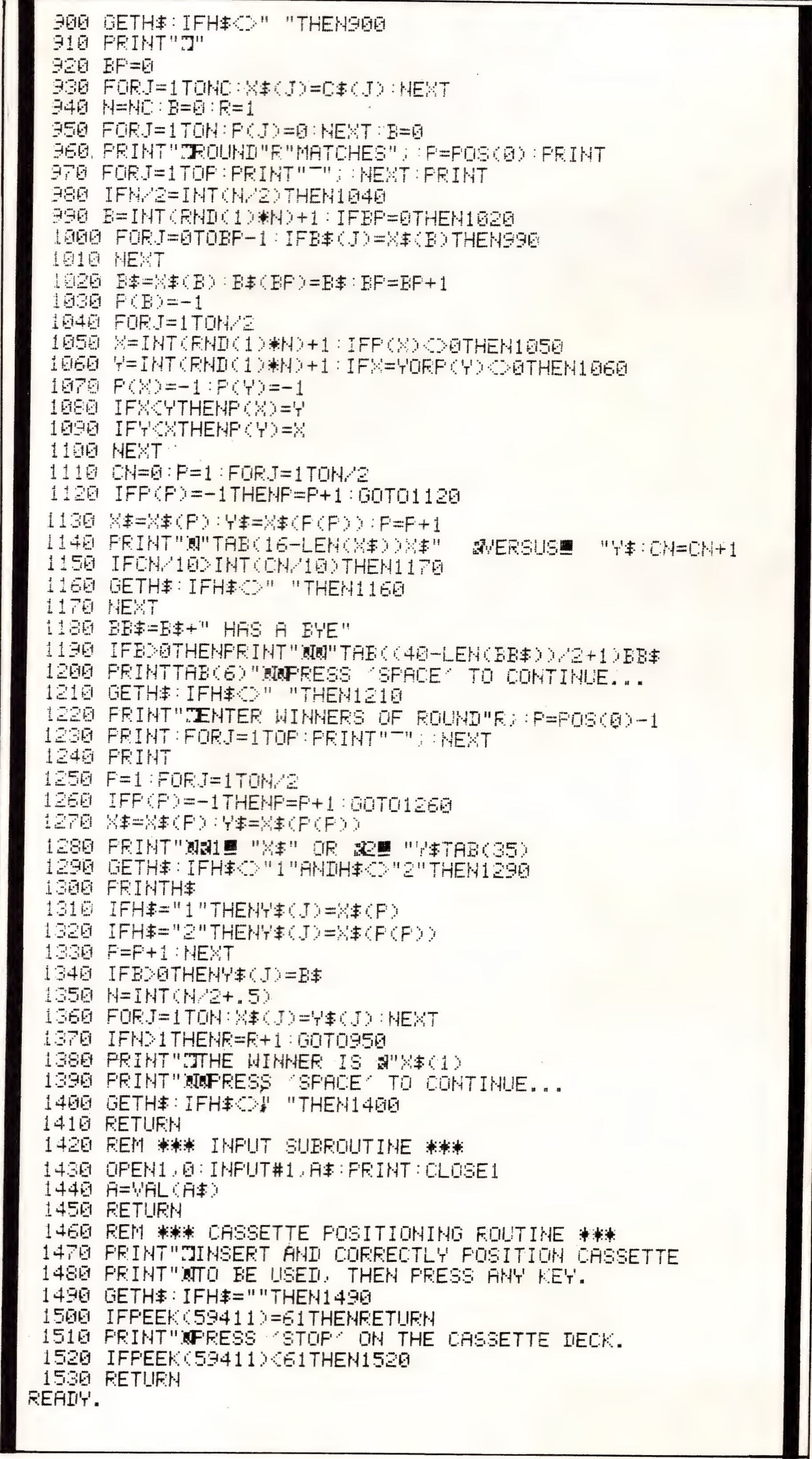

```
900 GETH$:IFH$<>" "THEN900
910 PRINT"■"
920 BP=0
930 FORJ=1TONC:X$(J)=C$(J):NEXT
940 N=NC:B=0:R=1
950 FORJ=1TON:P(J)=0:NEXT:B=0
960. PRINT"■ROUND"R"MATCHES";:P=POS(0):PRINT
970 FORJ=1TOP:PRINT"¯";:NEXT:PRINT
980 IFN/2=INT(N/2)THEN1040
990 B=INT(RND(1)*N)+1:IFBP=0THEN1020
1000 FORJ=0TOBP-1:IFB$(J)=X$(B)THEN990
1010 NEXT
1020 B$=X$(B):B$(BP)=B$:BP=BP+1
1030 P(B)=-1
1040 FORJ=1TON/2
1050 X=INT(RND(1)*N)+1:IFP(X)<>0THEN1050
1060 Y=INT(RND(1)*N)+1:IFX=YORP(Y)<>0THEN1060
1070 P(X)=-1:P(Y)=-1
1080 IFX<YTHENP(X)=Y
1090 IFY<XTHENP(Y)=X
1100 NEXT
1110 CN=0:P=1:FORJ=1TON/2
1120 IFP(P)=-1THENP=P+1:GOTO1120
1130 X$=X$(P):Y$=X$(P(P)):P=P+1
1140 PRINT"■"TAB(16-LEN(X$))X$"  ■VERSUS■  "Y$:CN=CN+1
1150 IFCN/10>INT(CN/10)THEN1170
1160 GETH$:IFH$<>" "THEN1160
1170 NEXT
1180 BB$=B$+" HAS A BYE"
1190 IFB>0THENPRINT"■■"TAB((40-LEN(BB$))/2+1)BB$
1200 PRINTTAB(6)"■■PRESS 'SPACE' TO CONTINUE...
1210 GETH$:IFH$<>" "THEN1210
1220 PRINT"■ENTER WINNERS OF ROUND"R;:P=POS(0)-1
1230 PRINT:FORJ=1TOP:PRINT"¯";:NEXT
1240 PRINT
1250 P=1:FORJ=1TON/2
1260 IFP(P)=-1THENP=P+1:GOTO1260
1270 X$=X$(P):Y$=X$(P(P))
1280 PRINT"■■1■ "X$" OR ■2■ "Y$TAB(35)
1290 GETH$:IFH$<>"1"ANDH$<>"2"THEN1290
1300 PRINTH$
1310 IFH$="1"THENY$(J)=X$(P)
1320 IFH$="2"THENY$(J)=X$(P(P))
1330 P=P+1:NEXT
1340 IFB>0THENY$(J)=B$
1350 N=INT(N/2+.5)
1360 FORJ=1TON:X$(J)=Y$(J):NEXT
1370 IFN>1THENR=R+1:GOTO950
1380 PRINT"■THE WINNER IS ■"X$(1)
1390 PRINT"■■PRESS 'SPACE' TO CONTINUE...
1400 GETH$:IFH$<>" "THEN1400
1410 RETURN
1420 REM *** INPUT SUBROUTINE ***
1430 OPEN1,0:INPUT#1,A$:PRINT:CLOSE1
1440 A=VAL(A$)
1450 RETURN
1460 REM *** CASSETTE POSITIONING ROUTINE ***
1470 PRINT"■INSERT AND CORRECTLY POSITION CASSETTE
1480 PRINT"■TO BE USED, THEN PRESS ANY KEY.
1490 GETH$:IFH$=""THEN1490
1500 IFPEEK(59411)=61THENRETURN
1510 PRINT"■PRESS 'STOP' ON THE CASSETTE DECK.
1520 IFPEEK(59411)<61THEN1520
1530 RETURN
READY.
```

PET Trains

by Jeff Aughton

Trains is great fun to play, and not just for children. A grid on the screen defines a track on which run an increasing number of trains. The player's job is to control these little trains and stop them hitting either each other or the buffers. Just to make things interesting, random closures of junctions have been thrown in as well. It is by no means an easy game to play, and it's unlikely that readers who key in this game will ever last longer than four minutes or so. As a program it is easy and clear to follow. It was tested on a 3032 PET.

```
100 DIMA$(12),P%(18),T%(8,3)
150 GOSUB9000
160 F=0:M=1:U=1:X=160:Y=163:Z=32768
200 D$="▚▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓▓"
210 A$(0)=" ◥◩◥▌███◤▀ ◥▌███◤◩◥▀ "
220 A$(1)="▌◩◥▀ ◪✱▌███▀◥◩◥▀ "
230 A$(2)="▌◤◩◥▌██▀ ◥▌██▌◪✱▀ "
240 A$(3)="◪◤▀◤▌██◤ ▌██▌ ◪✱"
250 A$(4)="◪◤▀◤ ▌███◤ ◪✱"
260 A$(5)="":A$(7)=""
270 A$(6)="  ◪✱▀ ▌███▌◪✱✱✱▀▌███▌ ◪✱▀ "
280 A$(8)=" ◥◩◥▌████✱▀ ◥"
290 A$(9)="  ◪✱▌██◤▀ ▌██◤◥◩◥"
300 A$(10)="▌◪✱▀ ▌██▌ ◪◤▌██◤▀◤"
310 A$(11)="▌◪✱▀ ◪◤▌███▀ ◪◤▀◤"
320 A$(12)="◪◤▀◤ ▌██◤ ◪◤▌███▀ ◪◤▀◤"
330 Z$="▚":FORI=1TO39:Z$=Z$+" "
340 NEXT:Z$=Z$+"▚"
350 IFV<.2THENA$(2)="▌◪ ▀ ▌██◪ ✱▌██▌ ▀ "
360 IFV<.4THENA$(8)="  ◪✱▀ ▌███◪    "
400 FORI=1TO8:T%(I,1)=203:T%(I,2)=-1
410 T%(I,3)=X:NEXT
500 PRINT"▚▓":FORI=1TO3
510 GOSUB7000:FORJ=1TO6
520 GOSUB7100:PRINT"◪ ":NEXTJ,I
530 GOSUB7000
540 POKE32849,233:POKE32885,223
550 POKE33689,95:POKE33725,105
560 FORI=0TO10:READJ:POKEZ+J,96:NEXT
600 FORI=65TO82:K$=CHR$(I)
610 GOSUB7200:IFP%(A)=5THENNEXT
620 IFRND(1)<.5THENP%(A)=12-P%(A)
630 PRINT"▚";K$;"▌█";A$(P%(A)):NEXT
640 PRINT"▓▓▓▓▓▓▓▌◪  ▀▁▌█┤ ▌█◤"
650 B=TI
1000 T=TI
1010 GETK$:IFK$<"A"ORK$>"R"THEN2000
1020 GOSUB7200:P%(A)=12-P%(A)
1030 PRINTA$(P%(A))
2000 D=T%(U,2):P=Z+T%(U,1):K=T%(U,3)
2010 IFK=XTHEN2050
2020 IFK=YORK=170ORK=32THEN6000
2040 D=40/D:IFKAND32THEND=-D
2050 T%(U,2)=D:POKEP,T%(U,3)
2060 IFPEEK(P+D)=96THENT%(U,2)=SGN((UAND1)
     -.5)*40/D:GOTO2000
2070 P=P+D:T%(U,3)=PEEK(P):POKEP,Y
2080 T%(U,1)=T%(U,1)+D
2090 FORI=1TO180/M-7*M:NEXT
2100 U=U+1:IFU>MTHENU=1
2110 IFTI-T<800*(1+RND(1))THEN1010
2115 IFTI-B>14400THEN6300
2120 IFFTHEN5200
2130 IFRND(1)<VTHENGOSUB5000
2140 M=M-(M<N):GOTO1000
4000 FORI=0TO12:PRINT"▚";TAB(I)K$
4010 FORJ=1TO110:NEXTJ,I
4020 PRINT:RETURN
4500 GETK$:IFK$<>" "THEN4500
4510 PRINT"▚";:RETURN
5000 Q=6-5*(RND(1)<.5)+INT(3*RND(1))
5010 K$=CHR$(Q+64):F=1
5020 PRINTZ$;" POINTS AT ";K$;" CLOSING DOWN SOON▓▓"
5030 PRINT"▌▌▌▌▌▌▌▌▌A▌▌▌▌▌▌▌▌▌B▌▌▌▌▌▌▌▌▌C"
5040 GOSUB7200:PRINT"▚";K$:RETURN
5200 PRINTZ$;:IFF=2THEN5400
5210 A=Q:GOSUB7205:PRINTA$(6)
5220 P%(A)=6:F=2:GOTO1000
5400 F=0:A=Q:P%(A)=0
5410 PRINT"POINTS NOW CLEAR"
5420 GOSUB7205:PRINTA$(0):GOTO1000
6000 B=INT((TI-B)/60)
6010 PRINTZ$;"CRAAAASH!!!!"
6020 S=37:FORI=0TO9:RESTORE:FORJ=1TO9
6030 READC:POKEP+C,S+I:NEXTJ,I
6040 FORI=1TO1000:NEXT
6050 PRINT"▚YOU SURVIVED FOR";B;"SECONDS"
6060 PRINT"▓▓YOUR SCORE IS";INT(100*(B/240)↑(1-V));"%"
6070 PRINT"▓▓PLAY AGAIN (Y/N)?"
6080 GETK$:IFK$="N"THENEND
6090 IFK$<>"Y"THEN6080
```

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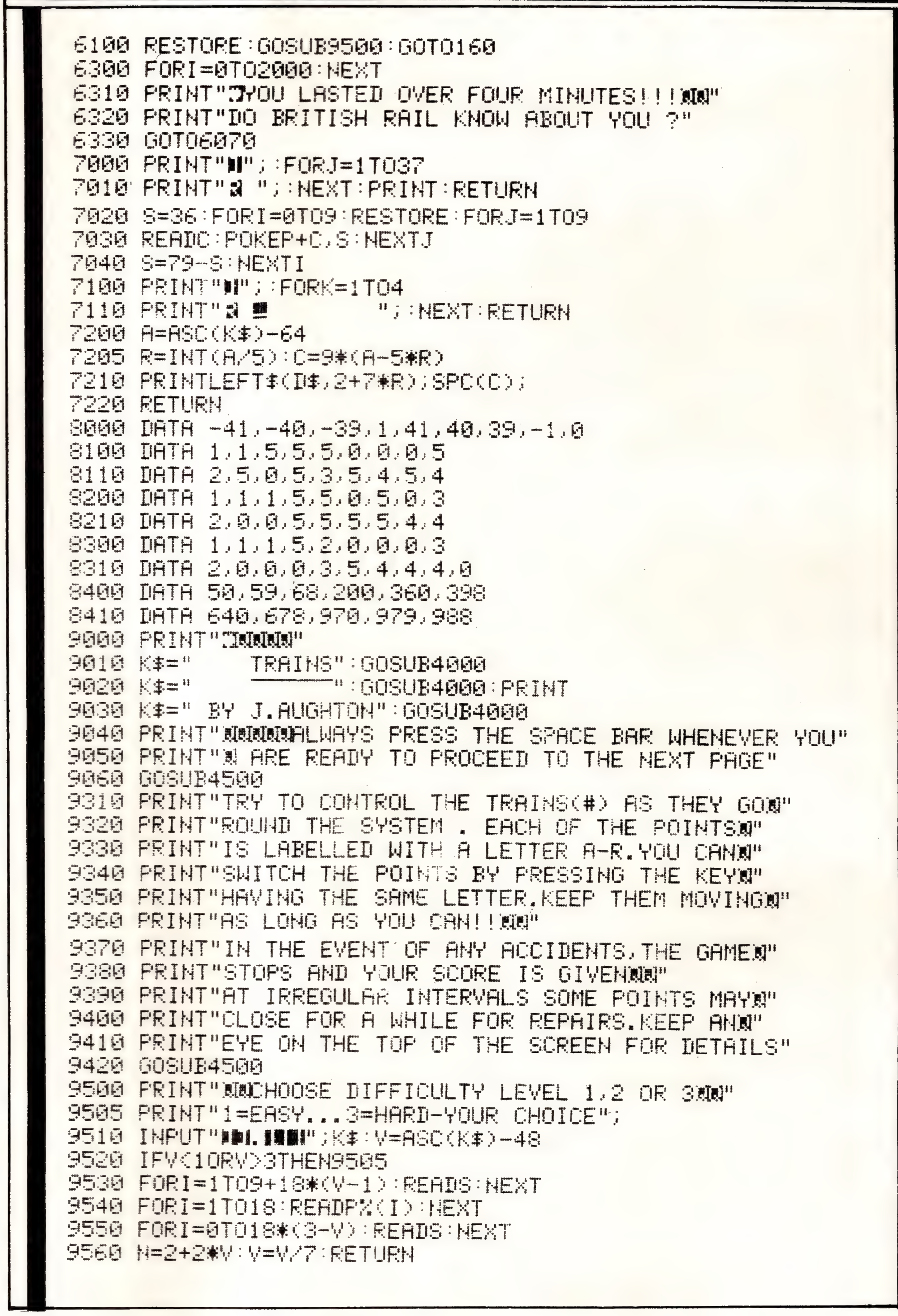

```
6100 RESTORE:GOSUB9500:GOTO160
6300 FORI=0TO2000:NEXT
6310 PRINT"▮YOU LASTED OVER FOUR MINUTES!!!▮▮"
6320 PRINT"DO BRITISH RAIL KNOW ABOUT YOU ?"
6330 GOTO6070
7000 PRINT"▮";:FORJ=1TO37
7010 PRINT"▮ ";:NEXT:PRINT:RETURN
7020 S=36:FORI=0TO9:RESTORE:FORJ=1TO9
7030 READC:POKEP+C,S:NEXTJ
7040 S=79-S:NEXTI
7100 PRINT"▮";:FORK=1TO4
7110 PRINT"▮ ▮          ";:NEXT:RETURN
7200 A=ASC(K$)-64
7205 R=INT(A/5):C=9*(A-5*R)
7210 PRINTLEFT$(D$,2+7*R);SPC(C);
7220 RETURN
8000 DATA -41,-40,-39,1,41,40,39,-1,0
8100 DATA 1,1,5,5,5,0,0,0,5
8110 DATA 2,5,0,5,3,5,4,5,4
8200 DATA 1,1,1,5,5,0,5,0,3
8210 DATA 2,0,0,5,5,5,5,4,4
8300 DATA 1,1,1,5,2,0,0,0,3
8310 DATA 2,0,0,0,3,5,4,4,4,0
8400 DATA 50,59,68,200,360,398
8410 DATA 640,678,970,979,988
9000 PRINT"▮▮▮▮▮"
9010 K$="     TRAINS":GOSUB4000
9020 K$="     ──────":GOSUB4000:PRINT
9030 K$=" BY J.AUGHTON":GOSUB4000
9040 PRINT"▮▮▮▮▮ALWAYS PRESS THE SPACE BAR WHENEVER YOU"
9050 PRINT"▮ ARE READY TO PROCEED TO THE NEXT PAGE"
9060 GOSUB4500
9310 PRINT"TRY TO CONTROL THE TRAINS(#) AS THEY GO▮"
9320 PRINT"ROUND THE SYSTEM . EACH OF THE POINTS▮"
9330 PRINT"IS LABELLED WITH A LETTER A-R.YOU CAN▮"
9340 PRINT"SWITCH THE POINTS BY PRESSING THE KEY▮"
9350 PRINT"HAVING THE SAME LETTER.KEEP THEM MOVING▮"
9360 PRINT"AS LONG AS YOU CAN!!▮▮"
9370 PRINT"IN THE EVENT OF ANY ACCIDENTS,THE GAME▮"
9380 PRINT"STOPS AND YOUR SCORE IS GIVEN▮▮"
9390 PRINT"AT IRREGULAR INTERVALS SOME POINTS MAY▮"
9400 PRINT"CLOSE FOR A WHILE FOR REPAIRS.KEEP AN▮"
9410 PRINT"EYE ON THE TOP OF THE SCREEN FOR DETAILS"
9420 GOSUB4500
9500 PRINT"▮▮CHOOSE DIFFICULTY LEVEL 1,2 OR 3▮▮"
9505 PRINT"1=EASY...3=HARD-YOUR CHOICE";
9510 INPUT"▮▮▮.▮▮▮▮";K$:V=ASC(K$)-48
9520 IFV<1ORV>3THEN9505
9530 FORI=1TO9+18*(V-1):READS:NEXT
9540 FORI=1TO18:READP%(I):NEXT
9550 FORI=0TO18*(3-V):READS:NEXT
9560 N=2+2*V:V=V/7:RETURN
```

'Case number 3 – Taxation Office versus Paul Jackson's TRS-80 Accountancy program.'

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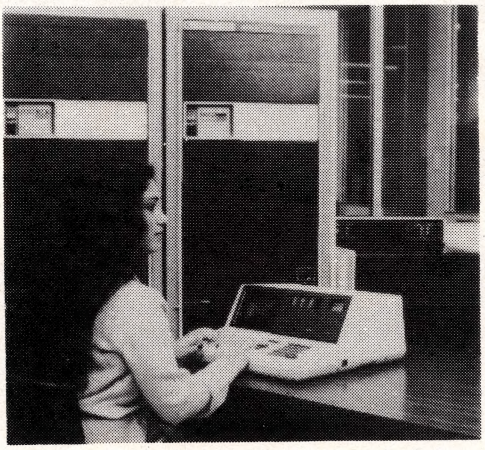

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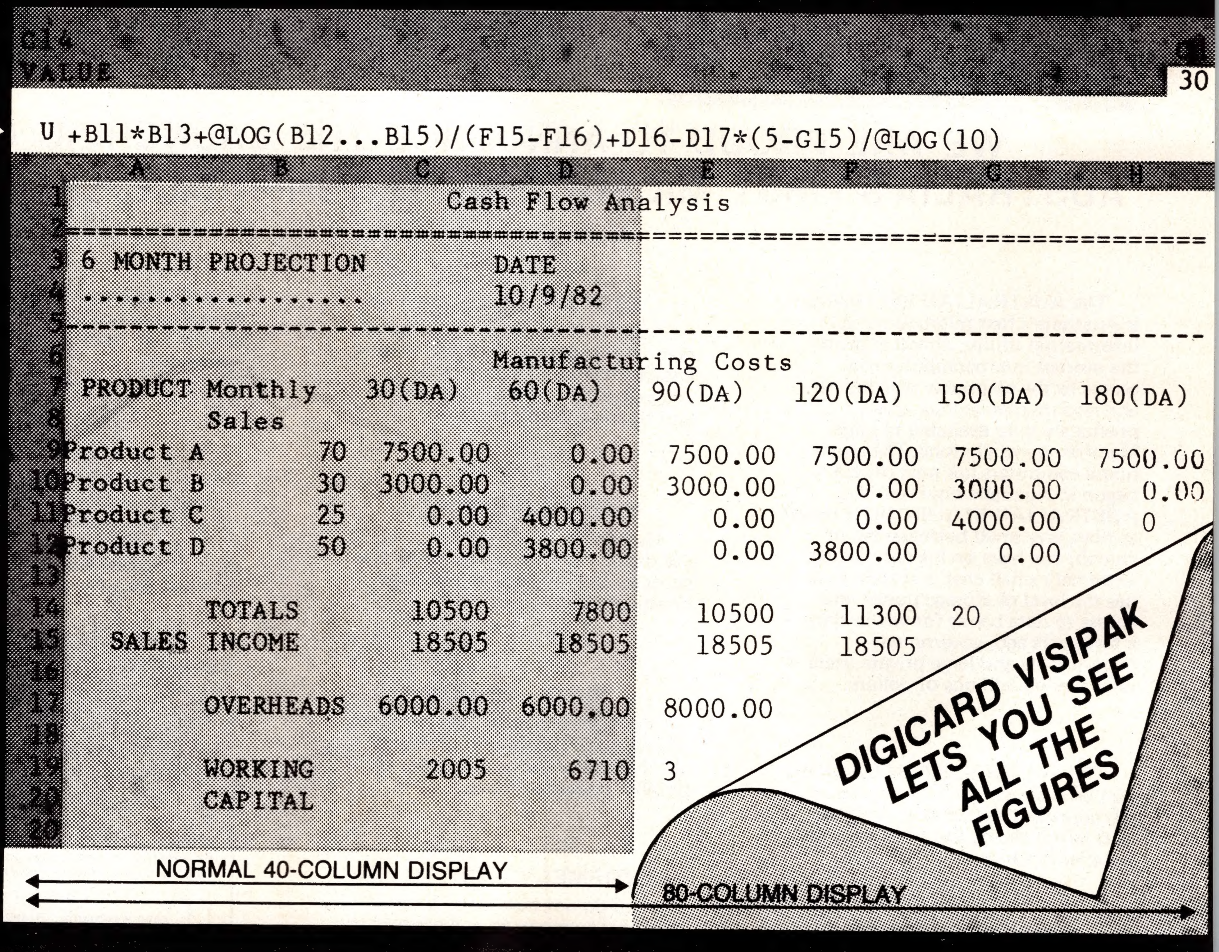

```
C14
VALUE                                                              30
U +B11*B13+@LOG(B12...B15)/(F15-F16)+D16-D17*(5-G15)/@LOG(10)
        A          B         C        D        E        F        G        H
 1                         Cash Flow Analysis
 2================================================================================
 3 6 MONTH PROJECTION             DATE
 4 ................               10/9/82
 5--------------------------------------------------------------------------------
 6                                Manufacturing Costs
 7 PRODUCT Monthly    30(DA)   60(DA)   90(DA)   120(DA)  150(DA)  180(DA)
 8         Sales
 9Product A      70  7500.00     0.00  7500.00  7500.00  7500.00  7500.00
10Product B      30  3000.00     0.00  3000.00     0.00  3000.00     0.00
11Product C      25     0.00  4000.00     0.00     0.00  4000.00     0
12Product D      50     0.00  3800.00     0.00  3800.00     0.00
13
14         TOTALS      10500     7800    10500    11300  20
15   SALES INCOME      18505    18505    18505    18505
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17         OVERHEADS 6000.00  6000.00  8000.00
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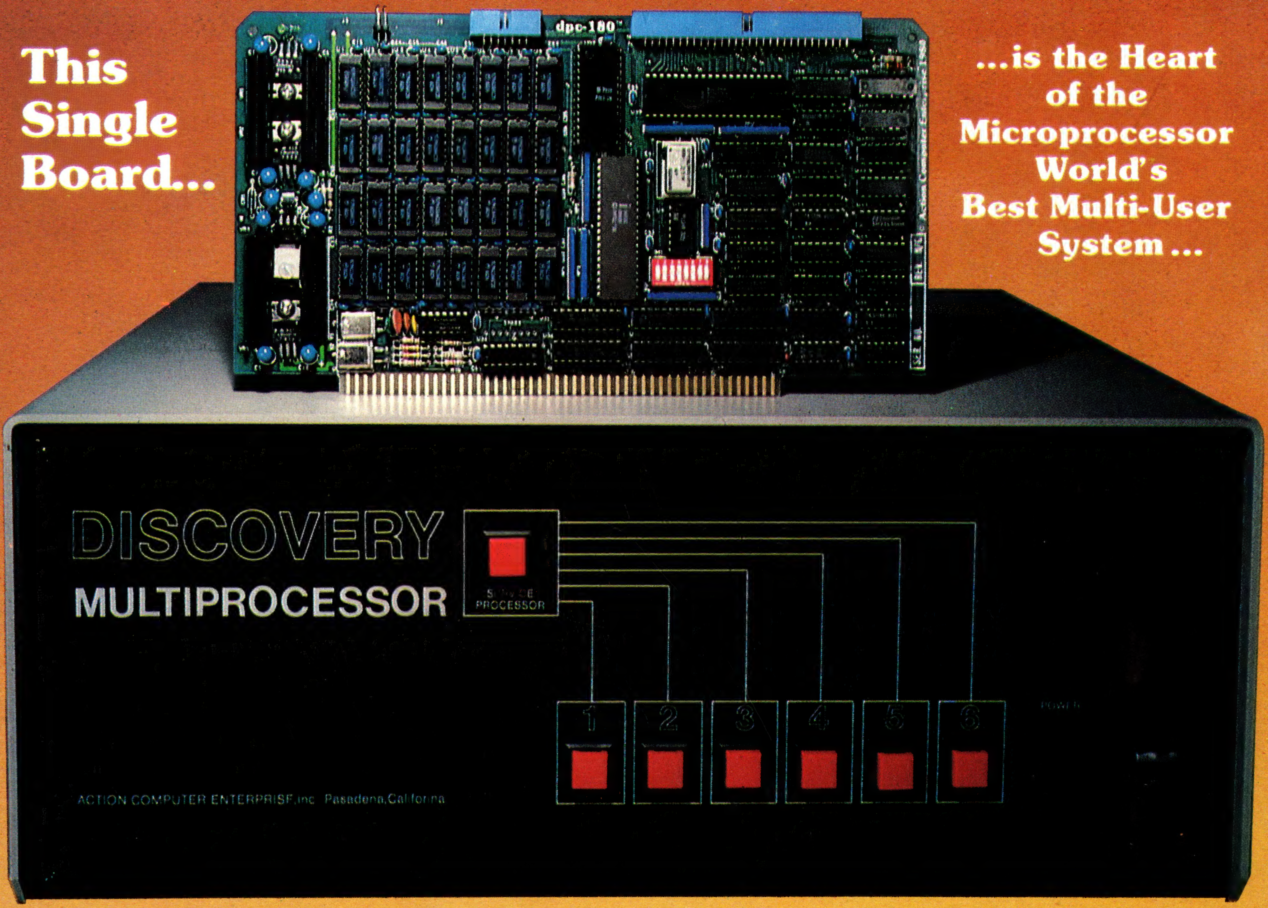

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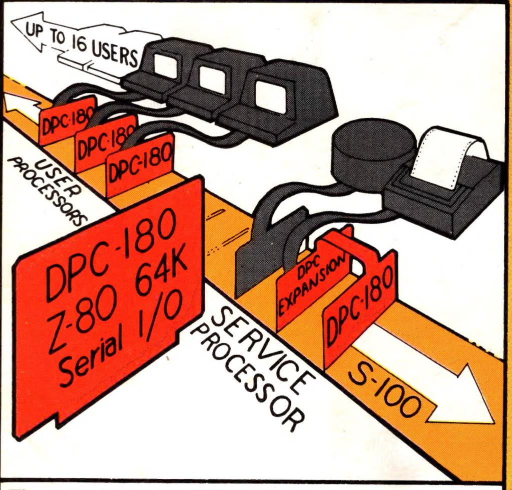
Our Distributed Processing Operating System, **dpc/os**©, resides in the Service Processor, establishing a CP/M environment for each user and managing access to the shared system resources. Multiuser facilities are provided for print spooling, for interprocessor communication and for private, public and shared-update files. Several processors can be employed concurrently by a single user via the enhanced batch submit facilities. And with **DISCOVERY** all CP/M compatible programs will execute without modification, thus protecting your software investment.

Multiprocessing Hardware

The ACE 64K Distributed Processing Single Board Computer, the **dpc-180**™ gives the **DISCOVERY** MULTIPROCESSOR its own unique architecture. One DPC is dedicated to each user providing exclusive use of the onboard Z-80, 64K ram and serial I/O. Access to the shared resources is provided by an expanded DPC used as a Service Processor. Additional users can be added at any time by simply inserting additional DPC's into the standard S-100 bus — up to a total of sixteen user processors in a single chassis!

*CP/M is a registered TM of Digital Research, Inc.



The ACE **DISCOVERY MULTIPROCESSOR** dedicates a complete 64K Z-80 Distributed Processing single board Computer, the **dpc-180**™ to each user. An expanded DPC coordinates all of the system activities.

Multiuser mainframes with 192K ram start at under $6600 The 64K **dpc-180**™ is priced at **$1424** Immediate delivery. A complete line of standard peripherals including a 33M byte hard disk subsystem can be supplied on request.

Dealer and OEM inquiries are invited.

DISCOVERY has been proven in installations throughout the World. If you need the Power of Multiprocessing... it's time you discovered us!

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